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Eakins

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(54) **STOWAGE BIN WITH CLOSING FORCE ASSISTANCE**

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G05D 3/00 (2006.01)
G05D 15/01 (2006.01)

(52) **U.S. Cl.**
CPC ***B64D 11/003*** (2013.01); ***G05D 3/00*** (2013.01); ***G05D 15/01*** (2013.01)

(58) **Field of Classification Search**
USPC 701/49
See application file for complete search history.

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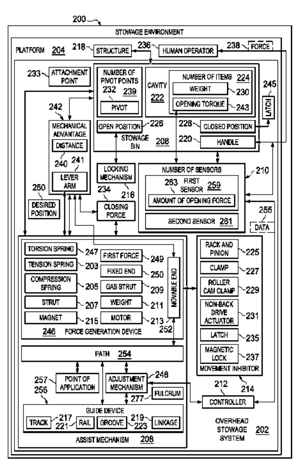
(57) **ABSTRACT**

A method and apparatus for providing a closing force. The apparatus comprises a stowage bin, a number of sensors that measure a number of forces on the stowage bin, an assist mechanism that provides a closing force, a controller that compares data from the number of sensors, and an adjustment mechanism that adjusts the closing force based on the data from the number of sensors. The assist mechanism has a mechanical advantage that changes to provide the closing force.

23 Claims, 16 Drawing Sheets



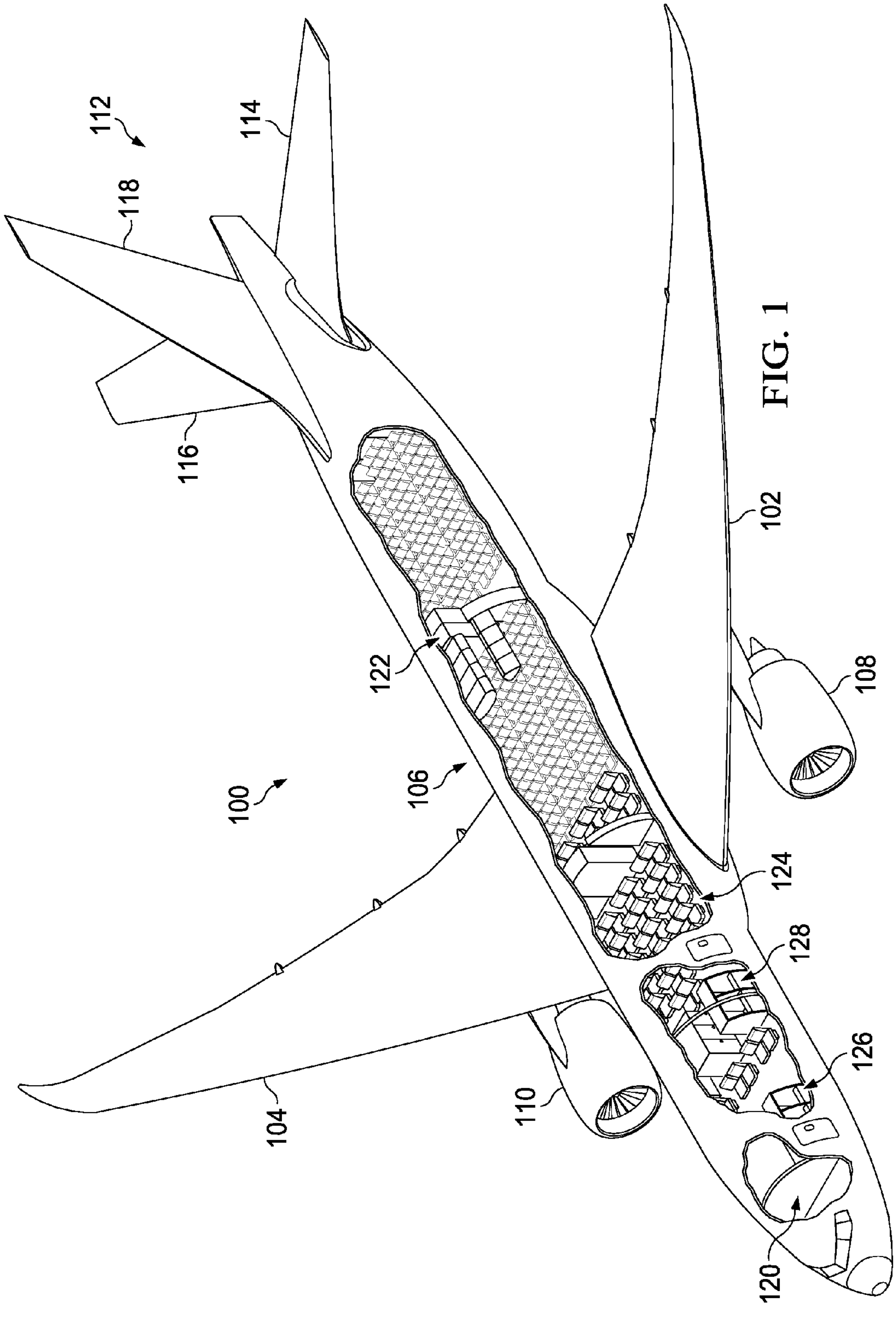
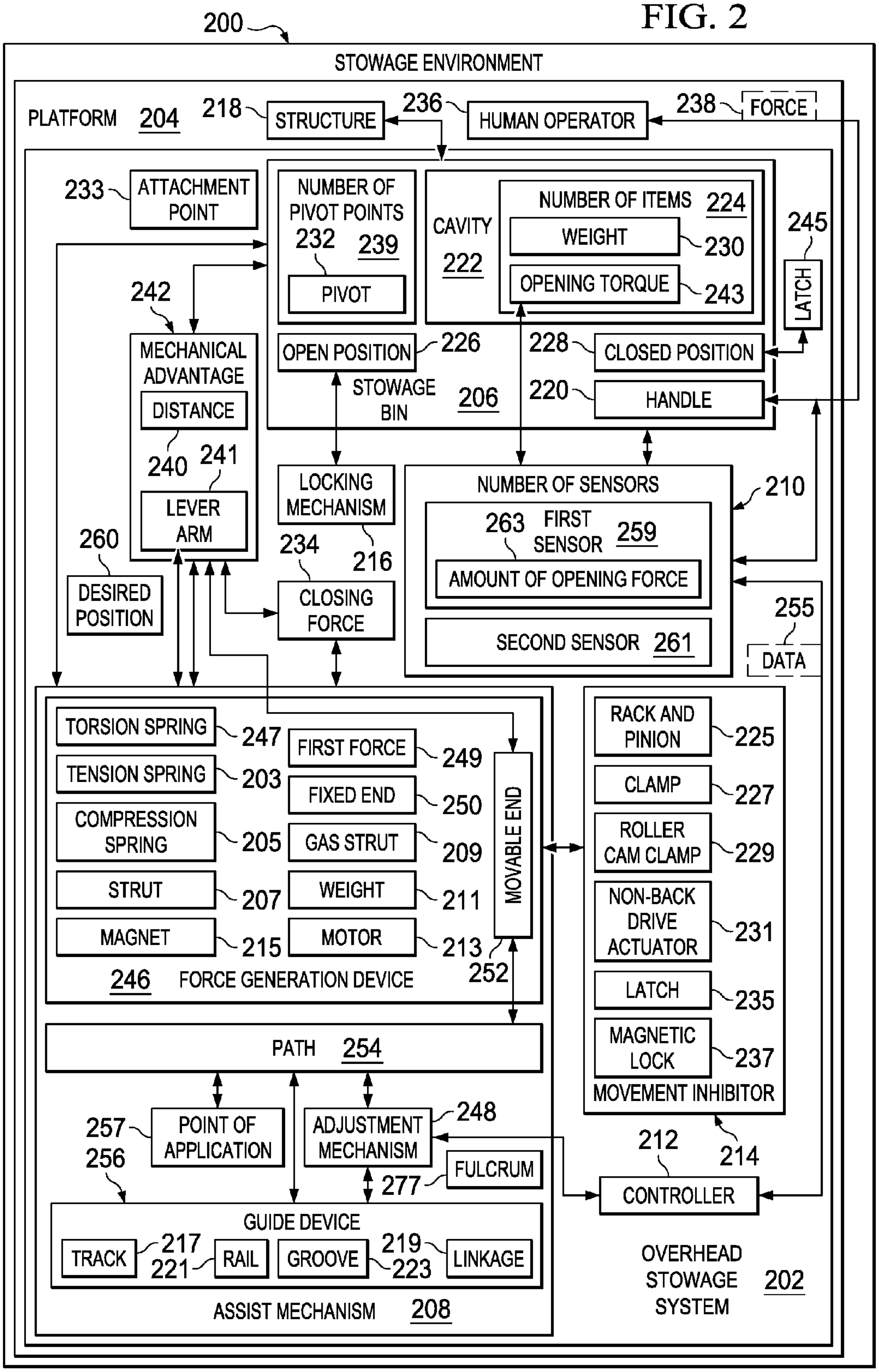


FIG. 1

FIG. 2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STOWAGE ENVIRONMENT
PLATFORM 204
218
STRUCTURE
236
HUMAN OPERATOR
238
FORCE
233
ATTACHMENT POINT
NUMBER OF PIVOT POINTS
232 239
PIVOT
CAVITY
222
NUMBER OF ITEMS 224
WEIGHT
230
OPENING TORQUE
243
245
LATCH
242
MECHANICAL ADVANTAGE
DISTANCE
240 241
LEVER ARM
OPEN POSITION
226
STOWAGE BIN 206
228
CLOSED POSITION
220
HANDLE
LOCKING MECHANISM
234
216
NUMBER OF SENSORS
210
263 FIRST SENSOR 259
AMOUNT OF OPENING FORCE
SECOND SENSOR 261
260
DESIRED POSITION
CLOSING FORCE
255
DATA
TORSION SPRING
247
TENSION SPRING
203
COMPRESSION SPRING
205
STRUT
207
MAGNET
215
FIRST FORCE
249
FIXED END
250
GAS STRUT
209
WEIGHT
211
MOTOR
213
MOVABLE END
252
246 FORCE GENERATION DEVICE
RACK AND PINION
225
CLAMP
227
ROLLER CAM CLAMP
229
NON-BACK DRIVE ACTUATOR
231
LATCH
235
MAGNETIC LOCK
237
MOVEMENT INHIBITOR
PATH 254
257
256
POINT OF APPLICATION
ADJUSTMENT MECHANISM
248
FULCRUM
277
212
214
CONTROLLER
GUIDE DEVICE
TRACK
217
221
RAIL
GROOVE
219
223
LINKAGE
ASSIST MECHANISM 208
OVERHEAD STOWAGE SYSTEM 202

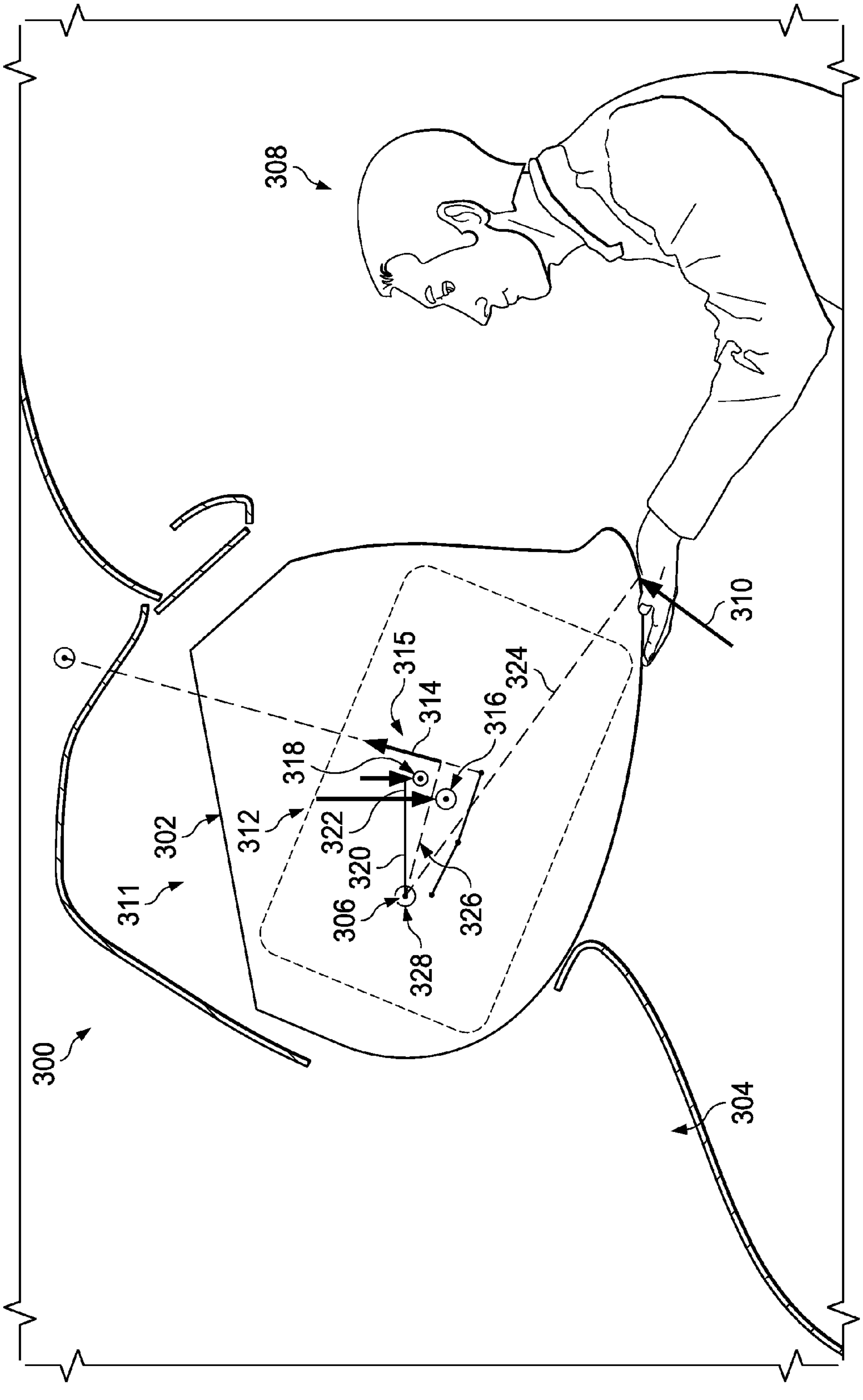
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FIG. 3

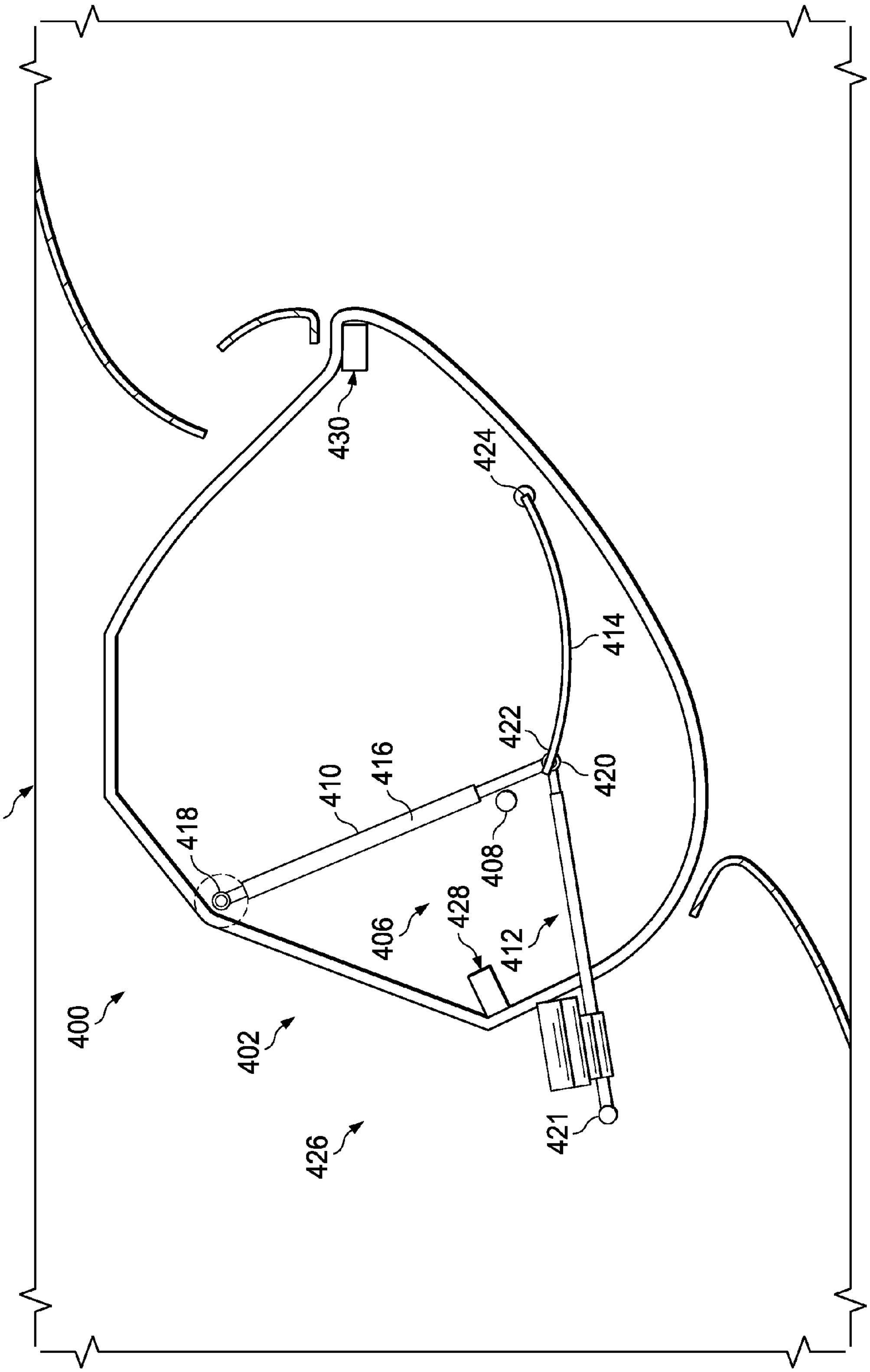
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FIG. 4

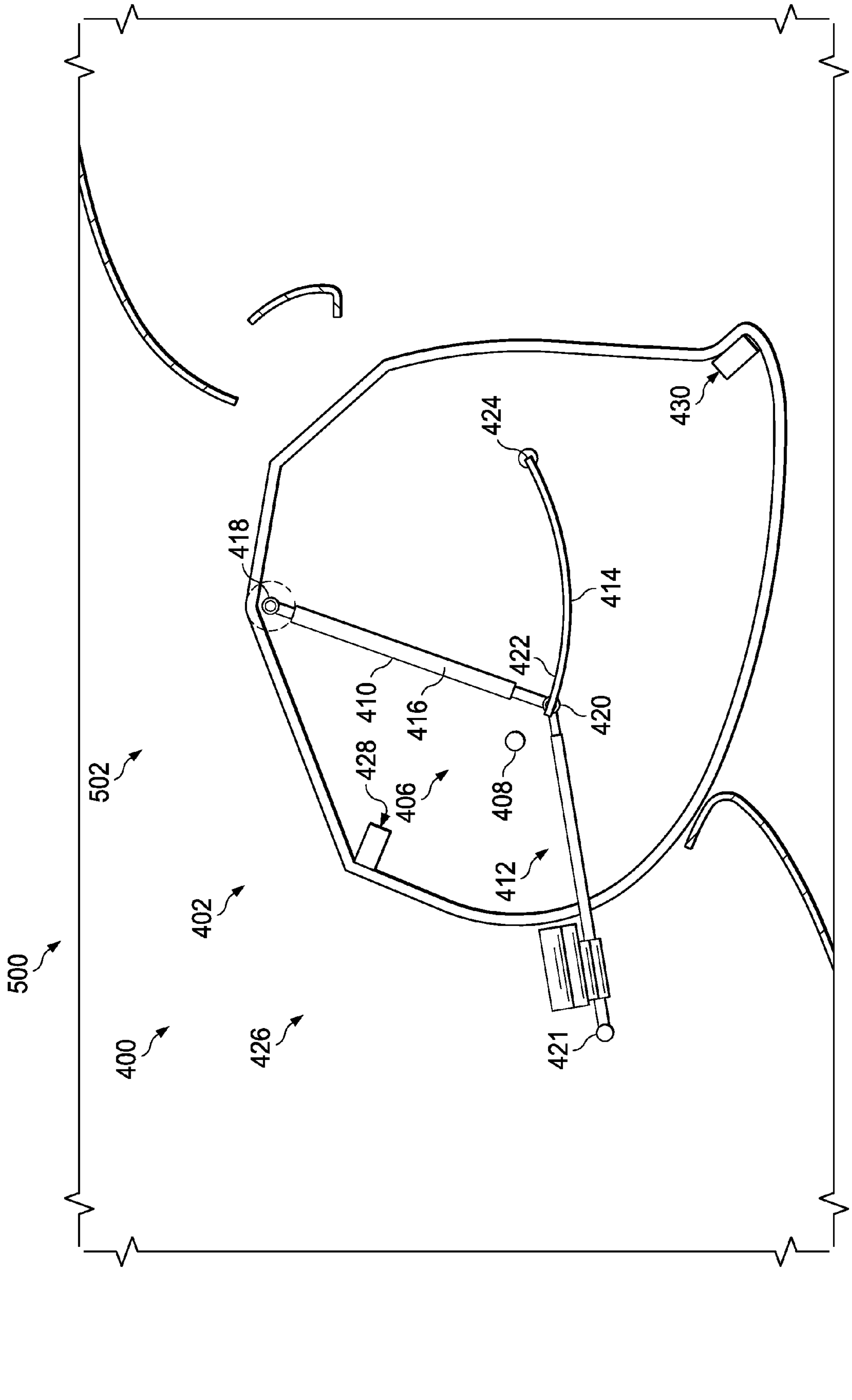
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FIG. 5

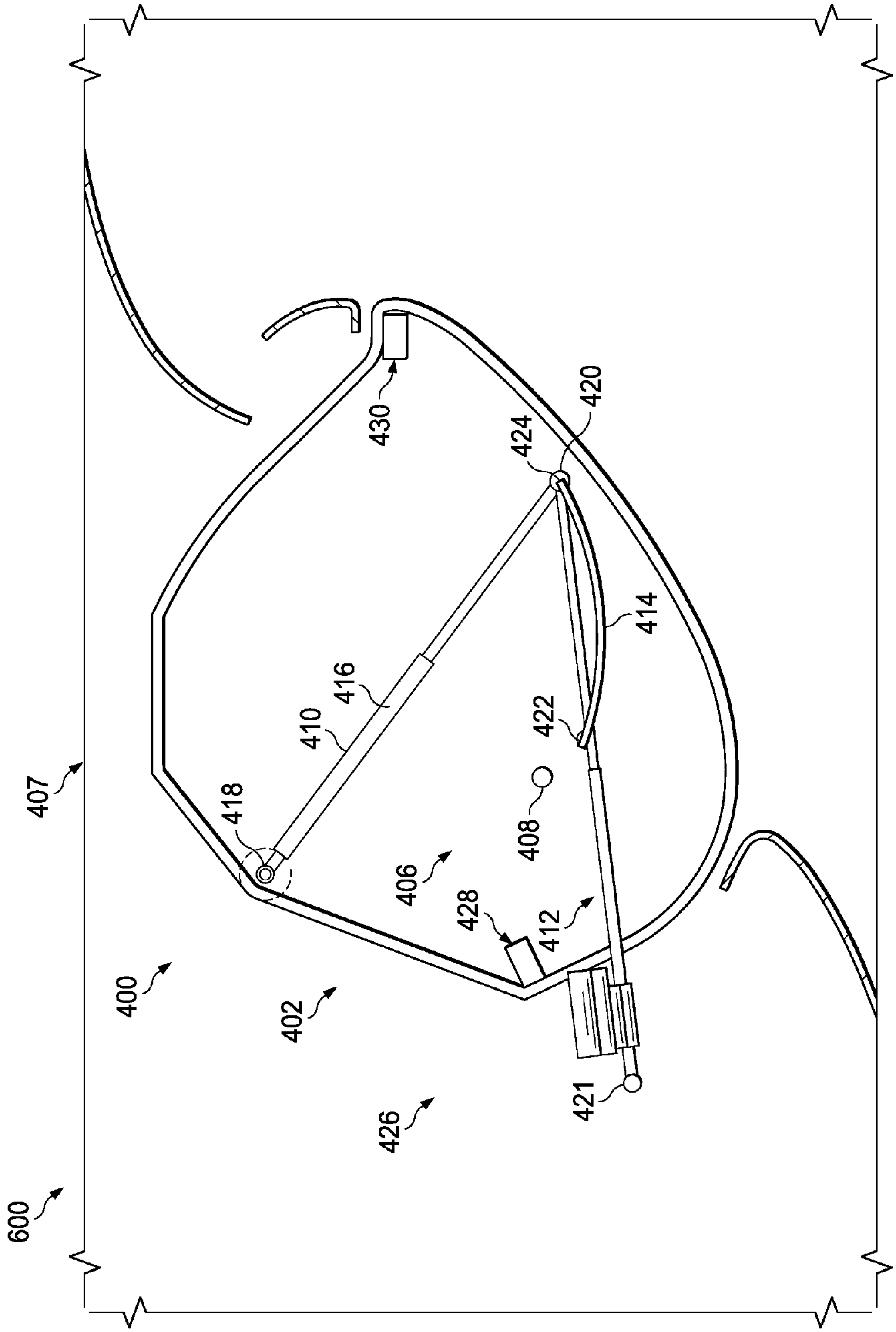

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FIG. 6

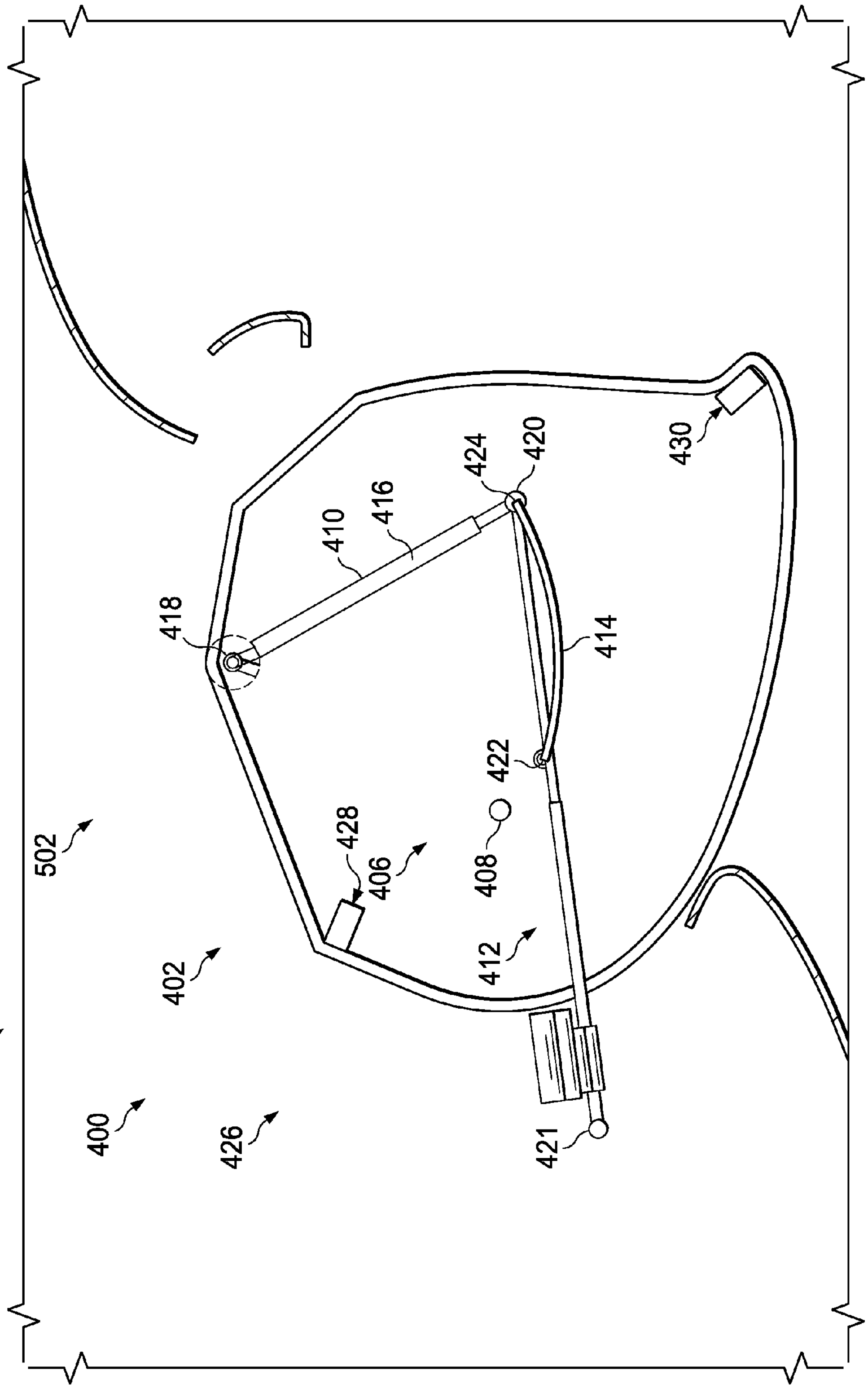
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FIG. 7

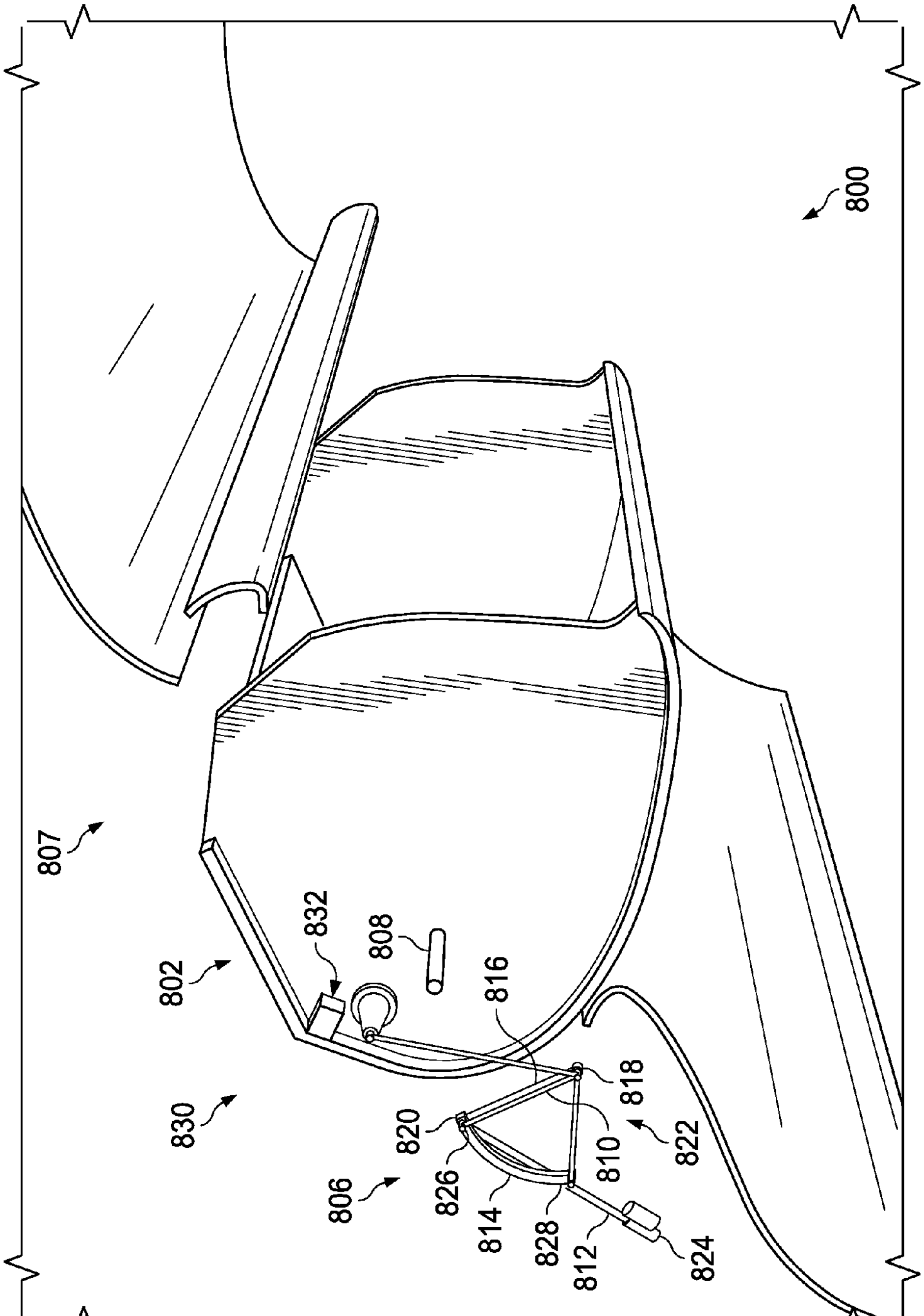

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FIG. 8

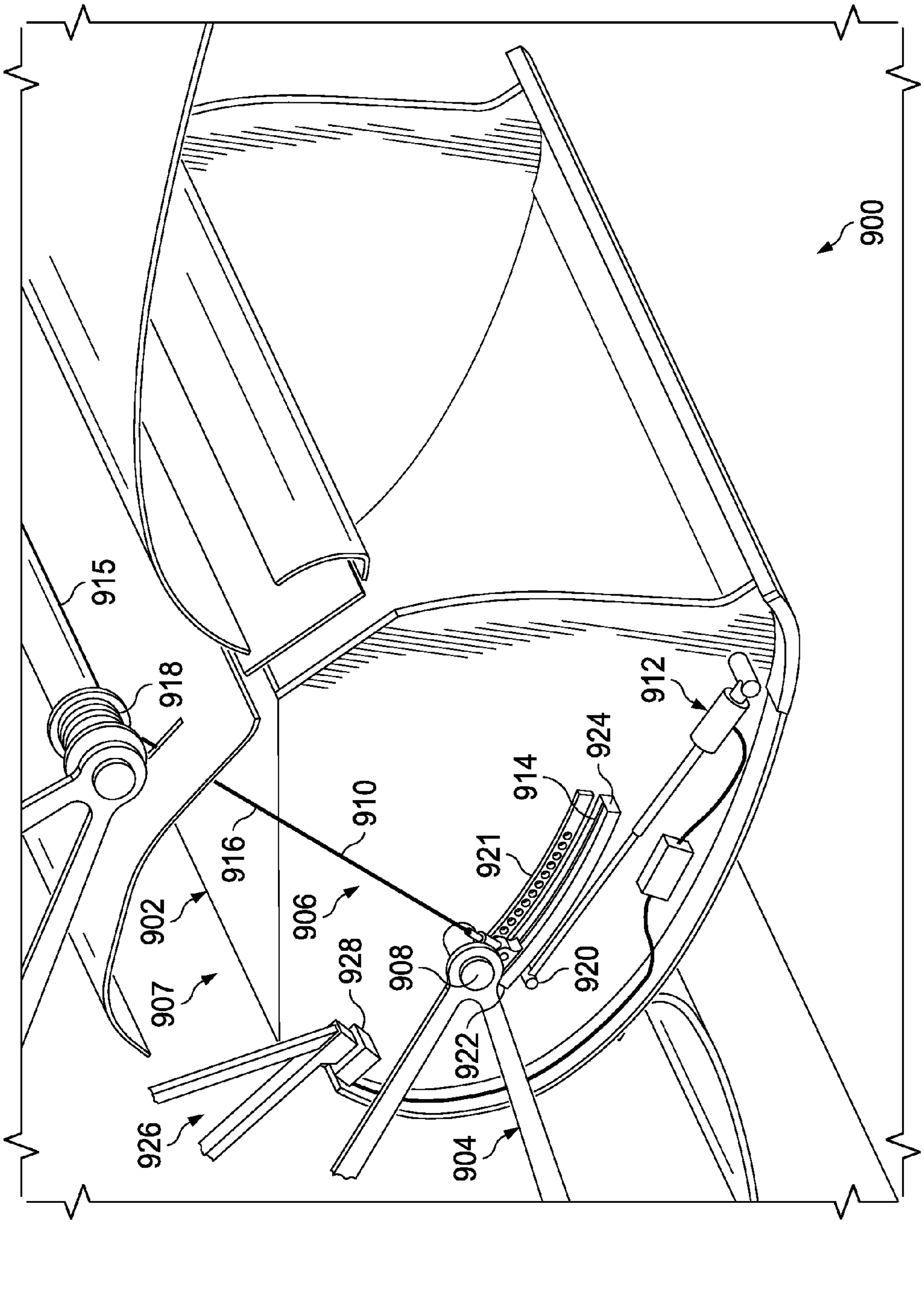
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FIG. 9

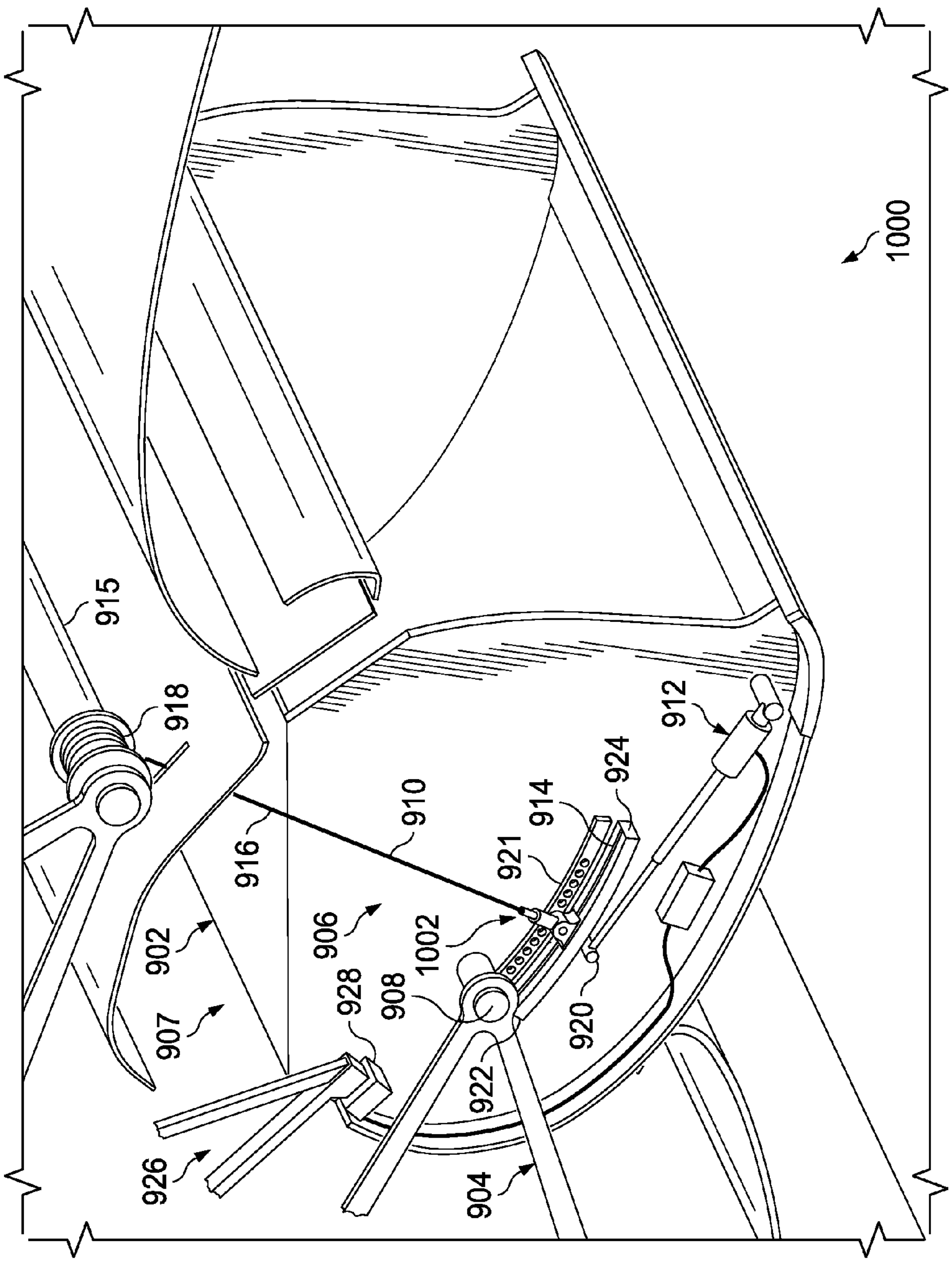

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FIG. 10

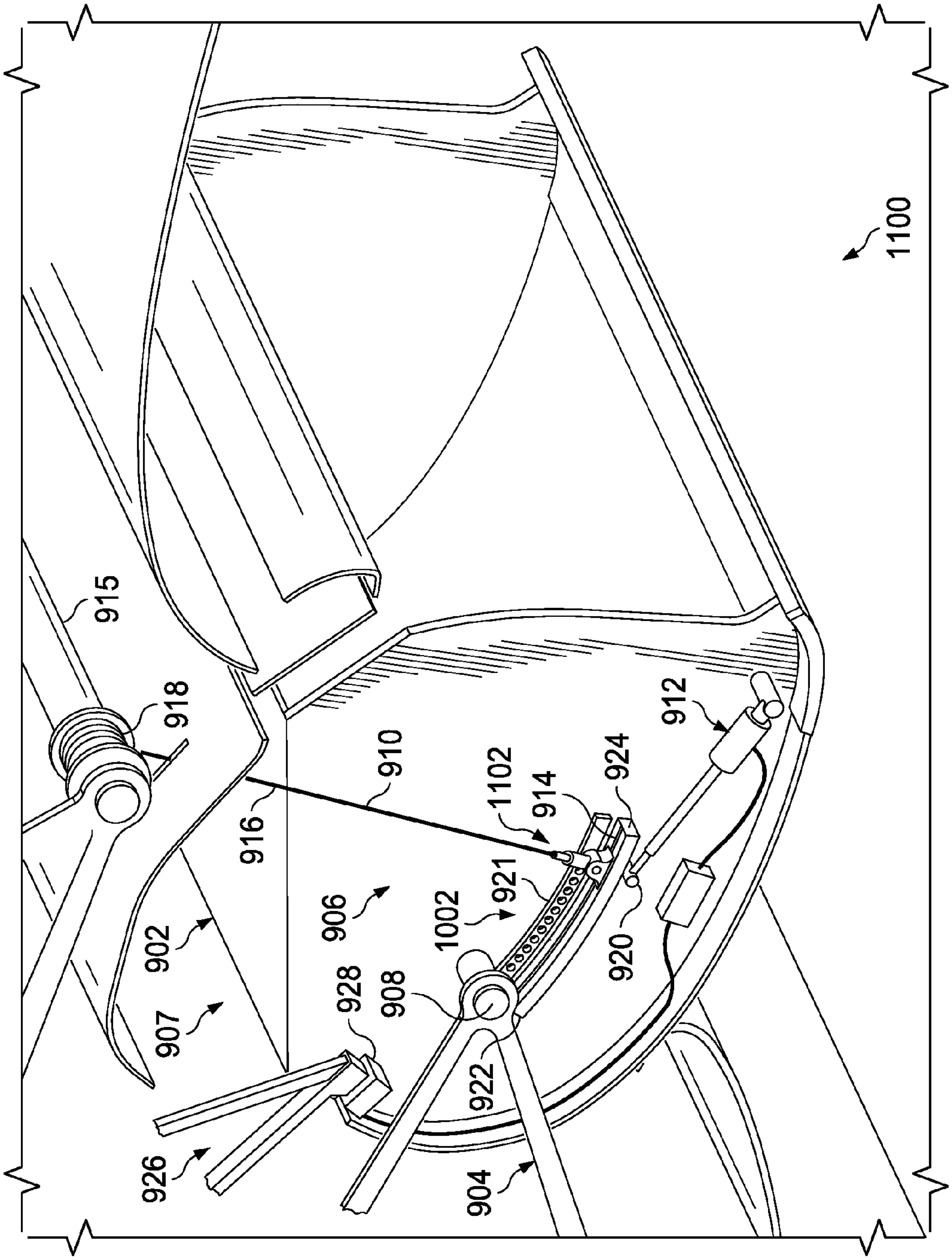
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FIG. 11

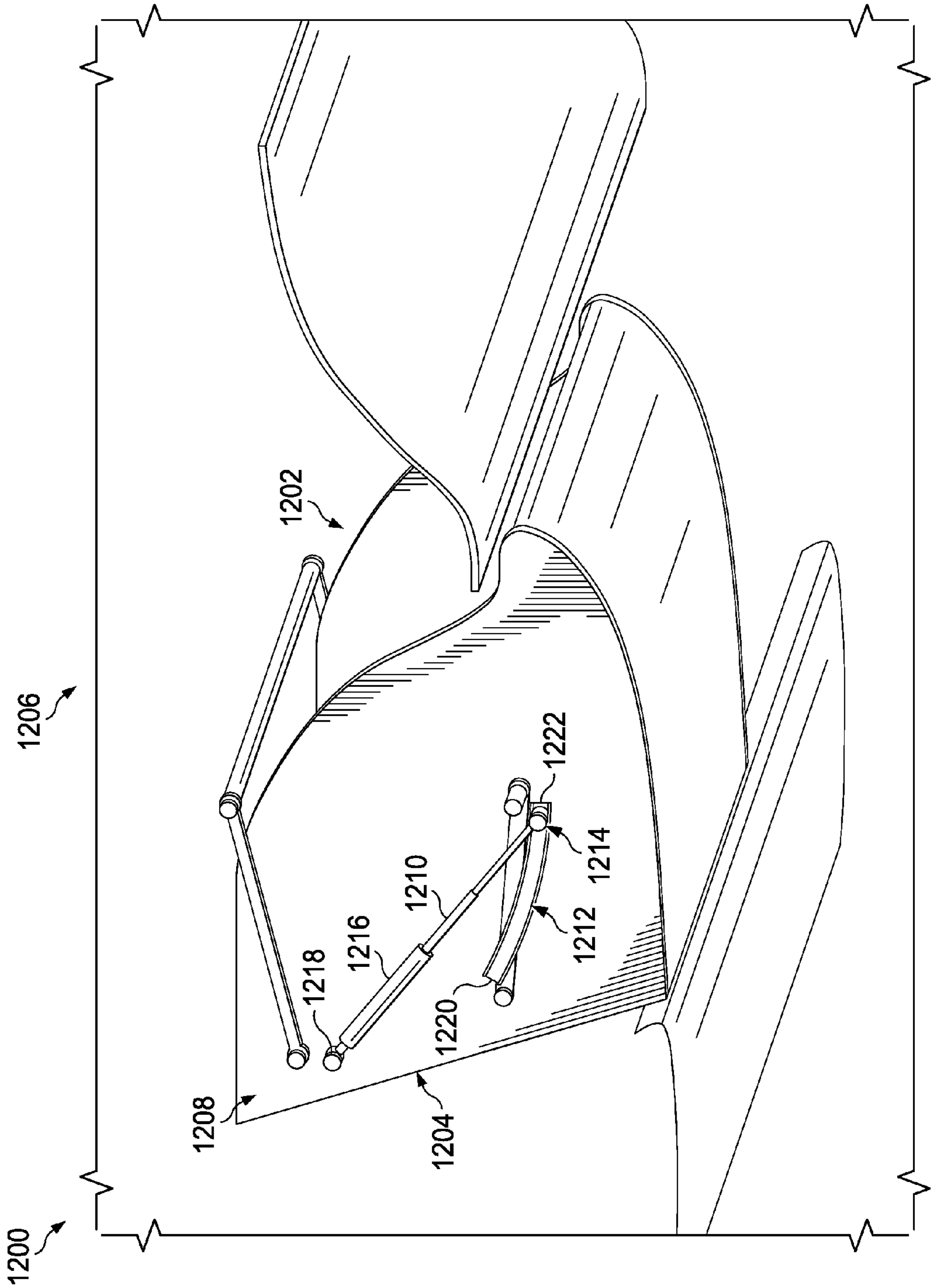

FIG. 12

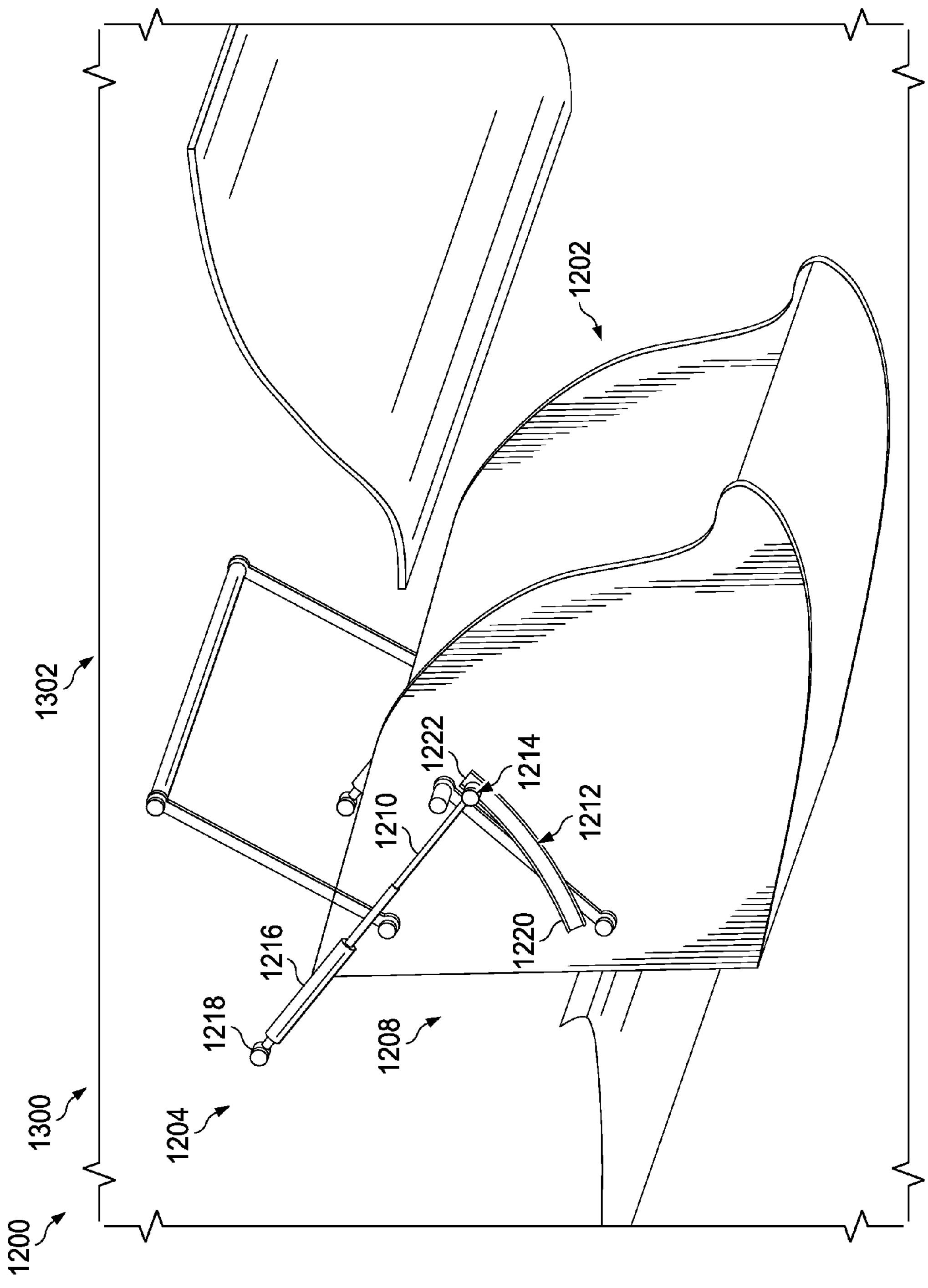
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FIG. 13

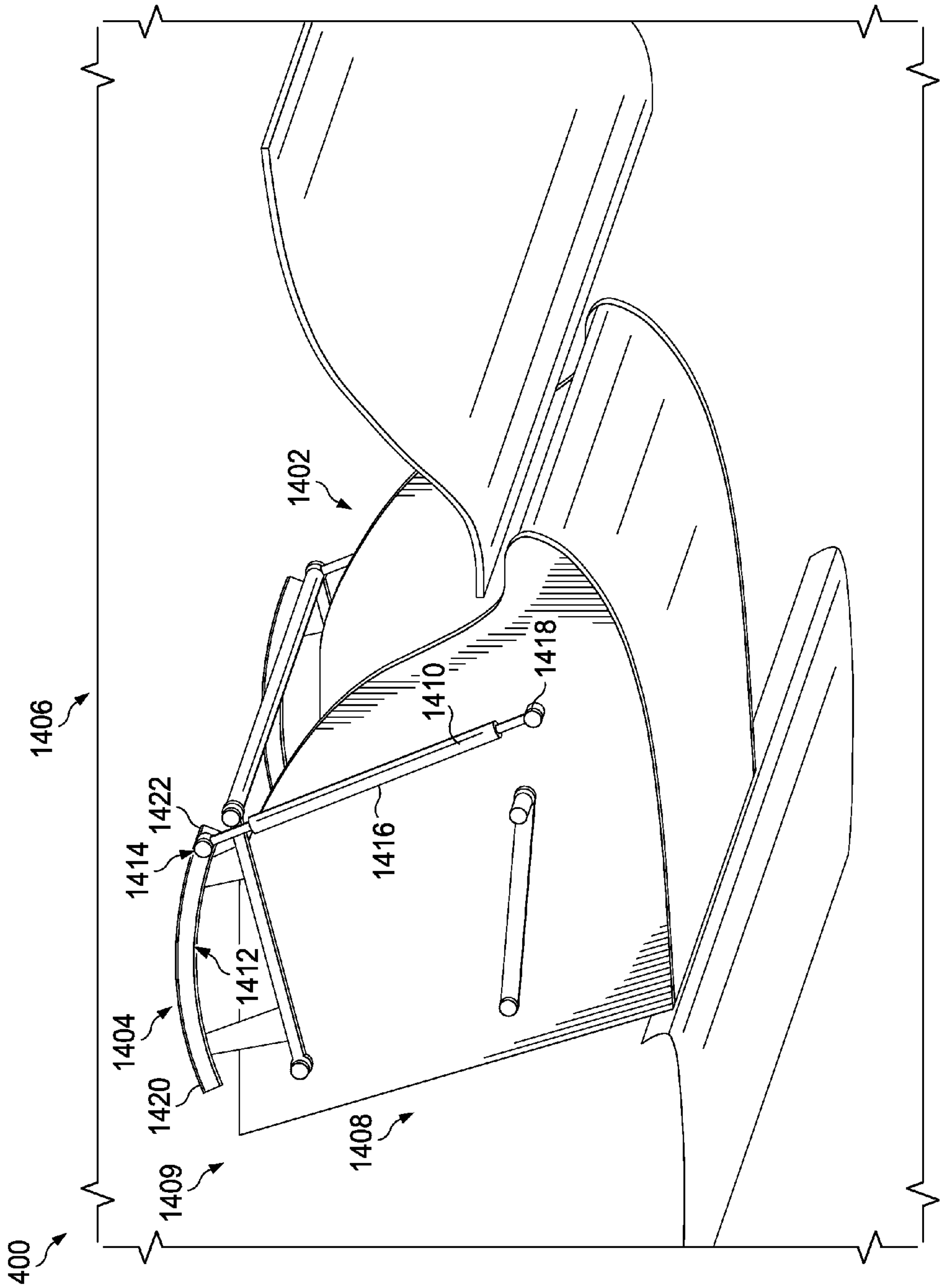
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FIG. 14

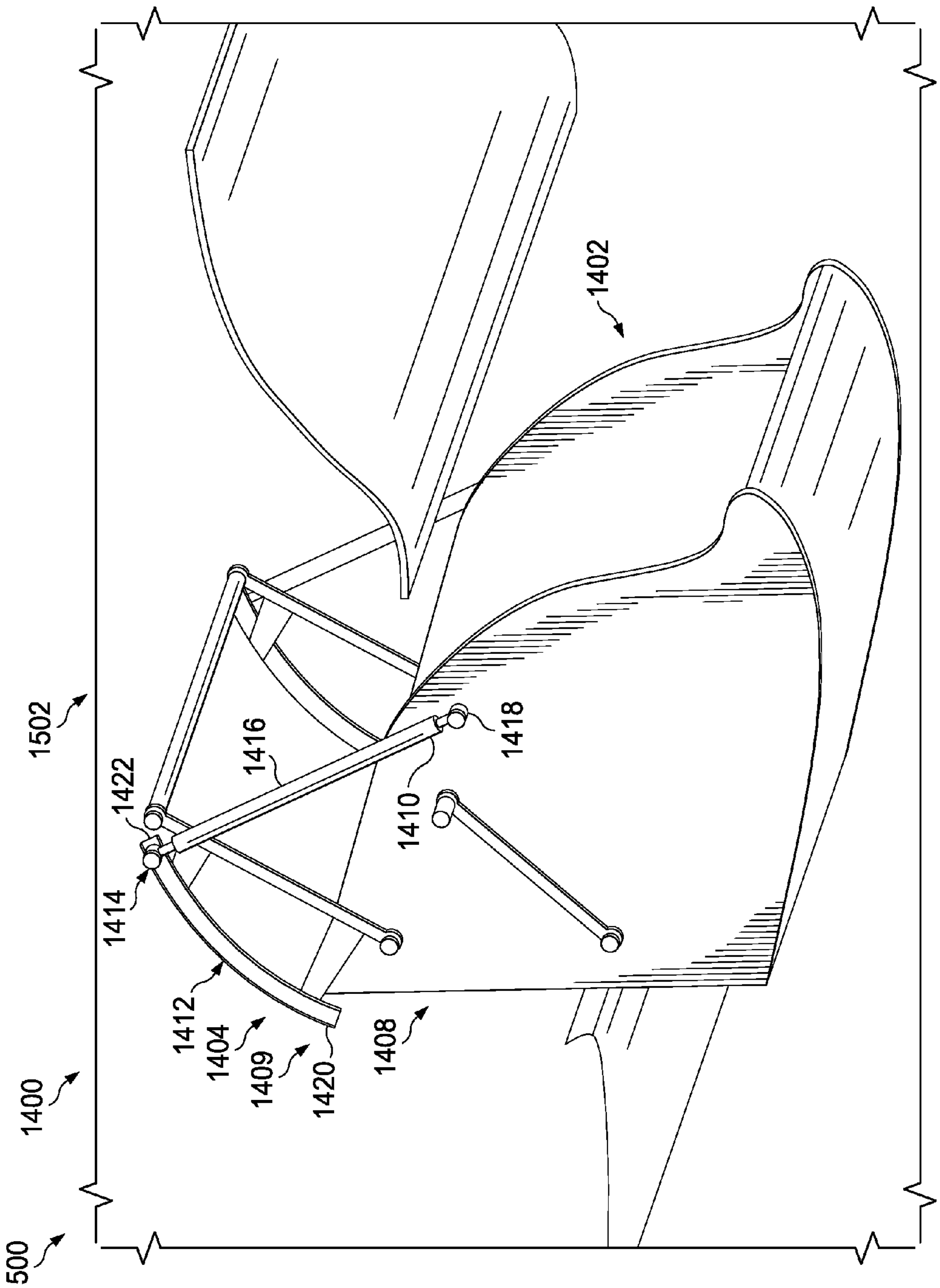
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FIG. 15

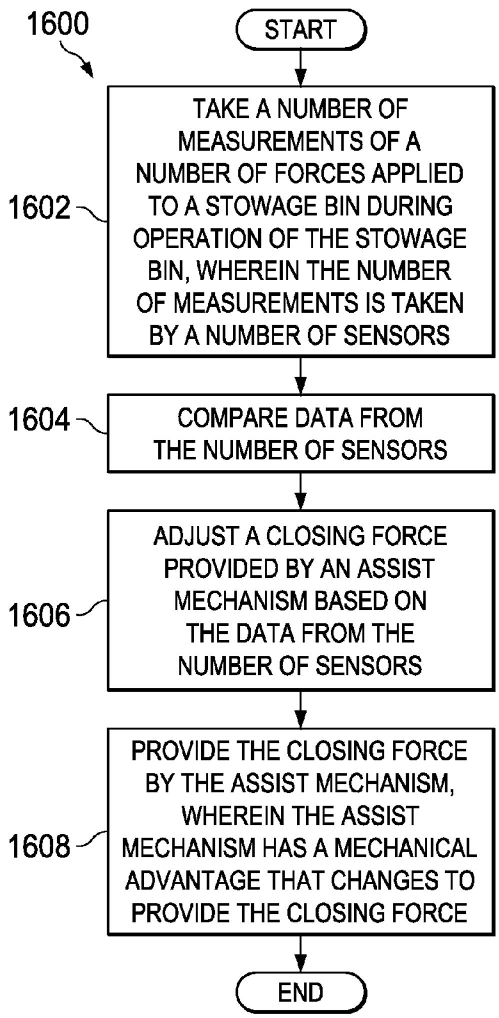

FIG. 16

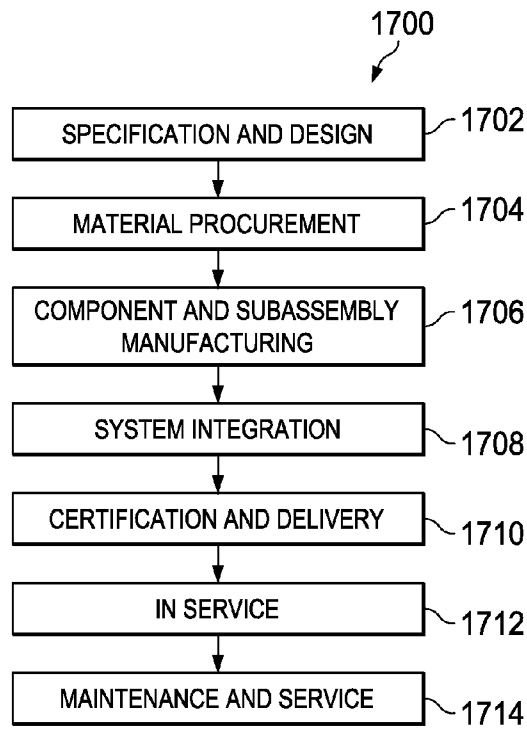

FIG. 17

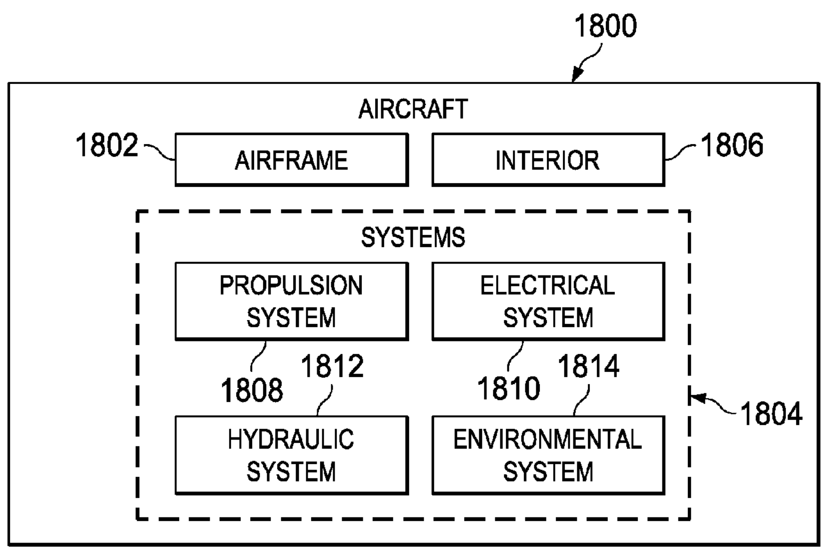

FIG. 18

STOWAGE BIN WITH CLOSING FORCE ASSISTANCE

BACKGROUND INFORMATION

1. Field

The present disclosure relates generally to storage of items, and in particular, to overhead storage of items. Still more particularly, the present disclosure relates to an apparatus for storing items in an overhead stowage bin in an aircraft.

2. Background

In commercial aviation, passengers may bring carry-on luggage into the passenger cabin of the aircraft. This luggage may be stored within the passenger cabin in designated storage areas. Designated storage areas in the passenger cabin include areas on the floor underneath the passenger seats and overhead stowage bins.

A passenger places luggage in the overhead stowage bin when the overhead stowage bin is in an open position. After luggage is placed into an overhead stowage bin, the bin is closed.

Many designs for overhead stowage bins exist. Some overhead stowage bin designs include a stationary luggage bin and a rotating door. Other overhead stowage bin designs include a rotating luggage bin. Still other overhead stowage bin designs feature a luggage bin which is lowered into the passenger cabin.

As commercial airlines continue to charge baggage fees, an increasing number of passengers are bringing carry-on items into the passenger cabin. As a result, larger stowage bins are needed to accommodate the increase in carry-on luggage. Larger bins result in more luggage being placed into each bin, which increases the weight of items in the bin.

Commercial airlines also desire to improve passenger experience by providing more head room above seats in an aircraft. As a result, lowering the stowage bins may be undesirable. Some aircraft are even being designed with overhead stowage bins positioned higher in the passenger cabin than before.

When more luggage is placed into overhead stowage bins, these bins become more difficult to close than desired. Bins oriented higher above the passenger seats compound the problem, resulting in at least one of more force needed to close the stowage bin or greater distance to lift the items in the stowage bin. Therefore, it would be desirable to have a method and apparatus that take into account at least some of the issues discussed above, as well as other possible issues.

SUMMARY

An illustrative embodiment of the present disclosure provides an apparatus. The apparatus comprises a stowage bin, a number of sensors that measure a number of forces on the stowage bin, an assist mechanism that provides a closing force, a controller that compares data from the number of sensors, and an adjustment mechanism that adjusts the closing force based on the data from the number of sensors. The assist mechanism has a mechanical advantage that changes to provide the closing force.

A further illustrative embodiment of the present disclosure provides a method. The method comprises taking a number of measurements of a number of forces applied to a stowage bin during operation of the stowage bin. The number of measurements is taken by a number of sensors. The method also compares data from the number of sensors. The method further adjusts a closing force provided by an assist mechanism based on the data from the number of sensors. The method then provides the closing force by the assist mechanism. The assist mechanism has a mechanical advantage that changes to provide the closing force.

Another illustrative embodiment of the present disclosure provides an apparatus. The apparatus comprises a stowage bin, a pivot directly connected to the stowage bin and a structure such that the stowage bin may rotate about the pivot from an open position to a closed position, and an assist mechanism that provides a closing force. The assist mechanism has a mechanical advantage that changes to provide the closing force.

The features and functions can be achieved independently in various embodiments of the present disclosure or may be combined in yet other embodiments in which further details can be seen with reference to the following description and drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

The novel features believed characteristic of the illustrative embodiments are set forth in the appended claims. The illustrative embodiments, however, as well as a preferred mode of use, further objectives and features thereof, will best be understood by reference to the following detailed description of an illustrative embodiment of the present disclosure when read in conjunction with the accompanying drawings, wherein:

FIG. **1** is an illustration of an aircraft in which an illustrative embodiment may be implemented;

FIG. **2** is an illustration of a block diagram of a stowage environment in accordance with an illustrative embodiment;

FIG. **3** is an illustration of a force diagram of a stowage bin in accordance with an illustrative embodiment;

FIG. **4** is an illustration of one example of a closed stowage bin with minimal assistive closing force in accordance with an illustrative embodiment;

FIG. **5** is an illustration of one example of an open stowage bin with minimal assistive closing force in accordance with an illustrative embodiment;

FIG. **6** is an illustration of one example of a closed stowage bin with maximum assistive closing force in accordance with an illustrative embodiment;

FIG. **7** is an illustration of one example of an open stowage bin with maximum assistive closing force in accordance with an illustrative embodiment;

FIG. **8** is an illustration of another example of an open stowage bin with maximum assistive closing force in accordance with an illustrative embodiment;

FIG. **9** is an illustration of a further example of an open stowage bin with minimum assistive closing force in accordance with an illustrative embodiment;

FIG. **10** is an illustration of a further example of an open stowage bin with an assistive closing force in accordance with an illustrative embodiment;

FIG. **11** is an illustration of a further example of an open stowage bin with an assistive closing force in accordance with an illustrative embodiment;

FIG. **12** is an illustration of a simplified view of yet a further example of a closed stowage bin with a minimum assistive closing force in accordance with an illustrative embodiment;

FIG. **13** is an illustration of a simplified view of yet a further example of an open stowage bin with a minimum assistive closing force in accordance with an illustrative embodiment;

FIG. **14** an illustration of a simplified view of a yet further example of a closed stowage bin with a minimum assistive closing force in accordance with an illustrative embodiment;

FIG. **15** is an illustration of a simplified view of a yet further example of an open stowage bin with a minimum assistive closing force in accordance with an illustrative embodiment;

FIG. **16** is an illustration of a flowchart of a process for providing a closing force in accordance with an illustrative embodiment;

FIG. **17** is an illustration of a block diagram of an aircraft manufacturing and service method in accordance with an illustrative embodiment; and

FIG. **18** is an illustration of a block diagram of an aircraft in which an illustrative embodiment may be implemented.

DETAILED DESCRIPTION

The illustrative embodiments recognize and take into account a number of different considerations. For example, the illustrative embodiments recognize and take into account that overhead stowage bins are designed with passenger safety, passenger comfort, capacity, and weight in mind. The illustrative embodiments recognize and take into account that the design of a stowage bin may improve the comfort and ease of using the bin. For example, assist mechanisms may be connected to a stowage bin to provide a desirable amount of assistance in closing the bin.

The illustrative embodiments recognize and take into account, however, that some currently used assist mechanisms may not change the amount of closing force assistance in a desirable manner. For instance, some existing systems do not change the amount of assistance based on the weight of luggage in the bin. Changing the amount of assistance provided is desirable such that the bin may be closed easily, regardless of the weight of its contents.

The illustrative embodiments further recognize and take into account that it is desirable to provide closing assistance without adding more weight and complexity to the aircraft than desired. For example, the illustrative embodiments recognize and take into account that implementing components that require power to close the bin may add more weight than desired, increase the cost of the aircraft more than desired, degrade the performance of the aircraft, or a combination thereof.

Thus, the illustrative embodiments provide a method and apparatus for closing a stowage bin. An apparatus comprises an assist system connected to the stowage bin that assists in closing the stowage bin. The assist mechanism has a mechanical advantage that changes to provide a closing force. The closing force may be adjusted based on data from a number of sensors that measure a number of forces on the stowage bin. In some illustrative examples, the closing force may reduce a force required to move the stowage bin between an open position and a closed position.

With reference now to the figures, and in particular, with reference to FIG. **1**, an illustration of an aircraft is depicted in accordance with an illustrative embodiment. In this illustrative example, aircraft **100** has wing **102** and wing **104** attached to body **106**. Body **106** may also be referred to as a fuselage. Aircraft **100** includes engine **108** attached to wing **102** and engine **110** attached to wing **104**.

Body **106** has tail section **112**. Horizontal stabilizer **114**, horizontal stabilizer **116**, and vertical stabilizer **118** are attached to tail section **112** of body **106**.

Body **106** also has cockpit **120** and passenger cabin **122**. In this example, passenger cabin **122** may include passenger seating in seating area **124**. Passenger seating may include a number of aircraft seats. As used herein, a "number of" items means one or more items. For example, a number of aircraft seats means one or more aircraft seats.

Further, seating area **124** in passenger cabin **122** may also include storage areas, such as a number of overhead stowage bins. Passenger cabin **122** also may include lavatory **126** and galley area **128**. These two areas may be partitioned or separated from seating area **124** by a partitioning structure such as, for example, without limitation, a wall, a partition, a class divider, a lavatory, a galley, a curtain, a stair enclosure, or a bar unit.

This illustration of aircraft **100** is provided for purposes of illustrating one environment in which the different illustrative embodiments may be implemented. The illustration of aircraft **100** in FIG. **1** is not meant to imply architectural limitations as to the manner in which different illustrative embodiments may be implemented. For example, aircraft **100** is shown as a commercial passenger aircraft. The different illustrative embodiments may be applied to other types of aircraft, such as private passenger aircraft, a rotorcraft, and other suitable type of aircraft.

Also, other areas may be present in addition to seating area **124**, lavatory **126**, and galley area **128**. Other areas may include, for example, without limitation, closets, storage areas, lounges, and other suitable areas for passenger seating. As another example, airplane seats within seating area **124** may be arranged differently from the depicted example. In other illustrative embodiments, some seats may be grouped into sets of single seats instead of three seats or pairs of seats as is illustrated in seating area **124**.

Turning next to FIG. **2**, an illustration of a block diagram of a stowage environment is depicted in accordance with an illustrative embodiment. Stowage environment **200** is an environment in which overhead stowage system **202** is used in platform **204**. Aircraft **100** shown in FIG. **1** is an example of a physical implementation for platform **204** shown in block form in this figure.

As depicted, overhead stowage system **202** includes a number of different components. In this illustrative example, overhead stowage system **202** includes stowage bin **206**, assist mechanism **208**, number of sensors **210**, controller **212**, movement inhibitor **214**, and locking mechanism **216**.

In this depicted example, stowage bin **206** is a structure that holds items in aircraft **100**. In particular, stowage bin **206** is an overhead stowage bin. For example, stowage bin **206** may be oriented above passenger seats in seating area **124** in passenger cabin **122** of aircraft **100** shown in FIG. **1**.

Stowage bin **206** is connected to structure **218** in platform **204**. Structure **218** may take the form of at least one of a structural member, a housing, a frame, a wall, a ceiling, a skin panel, or other suitable structures in platform **204**.

As used herein, the phrase "at least one of," when used with a list of items, means different combinations of one or more of the listed items may be used and only one of the items in the list may be needed. The item may be a particular object, thing, or category. In other words, "at least one of" means any combination of items or number of items may be used from the list, but not all of the items in the list may be required.

For example, "at least one of item A, item B, and item C" may mean item A; item A and item B; item B; item A, item B, and item C; or item B and item C. In some cases, "at least one of item A, item B, and item C" may mean, for example, without limitation, two of item A, one of item B, and ten of item C; four of item B and seven of item C; or some other suitable combination.

In an illustrative example, stowage bin **206** has latch **245**, handle **220** and cavity **222**. Latch **245** may hold stowage bin **206** closed. After latch **245** is released, stowage bin **206** may be moved by a passenger applying force to handle **220**. Handle **220** is an object through which a passenger will interact with the bin.

Specifically, handle **220** is a portion of stowage bin **206** that may be used to move stowage bin **206**. For example, a passenger may push upward on handle **220** to close stowage bin **206**. Alternatively, a passenger may pull downward on handle **220** to open stowage bin **206**. In this illustrative example, cavity **222** is a space within stowage bin **206** that receives and holds number of items **224**.

As depicted, stowage bin **206** moves between open position **226** and closed position **228**. When stowage bin **206** is in open position **226**, stowage bin **206** may receive number of items **224**. Specifically, stowage bin **206** may receive number of items **224** in cavity **222**.

In this illustrative example, number of items **224** is one or more items. Items in number of items **224** may include at least one of a bag, a briefcase, a carry-on item, clothing, passenger comfort items, electronic devices, emergency equipment, food, beverages, plants, or other suitable types of luggage and non-luggage items.

Number of items **224** has weight **230** in this illustrative example. Weight **230** of number of items **224** changes as items are added or taken out of stowage bin **206**. For example, as additional items are placed into stowage bin **206**, weight **230** increases. As items are removed from stowage bin **206**, weight **230** decreases.

Once number of items **224** is placed in or removed from cavity **222**, stowage bin **206** may be moved to closed position **228**. In some illustrative examples, stowage bin **206** may then be latched or locked in closed position **228** by latch **245**. For instance, when platform **204** takes the form of an aircraft, stowage bin **206** is locked in closed position **228** during operation of the aircraft such that number of items **224** remains in stowage bin **206**.

As illustrated, stowage bin **206** moves between open position **226** and closed position **228** about number of pivot points **239**. In some designs of stowage bin **206**, stowage bin **206** may move about a single point, pivot **232**. Pivot **232** may be directly connected to stowage bin **206** and structure **218** such that stowage bin **206** may rotate about pivot **232** from open position **226** to closed position **228**. In more complex designs, number of pivot points **239** may be part of a four bar system, sliders, tracks or combinations thereof or other type of system in which stowage bin **206** moves about two or more pivot points. In some illustrative examples, number of pivot points **239** may be considered virtual pivot points.

Assist mechanism **208** generates a force used in closing stowage bin **206** in this illustrative example. Assist mechanism **208** may generate a force that assists in closing stowage bin **206**. Specifically, assist mechanism **208** may supply closing force **234** to stowage bin **206** to help human operator **236** close stowage bin **206**. In this manner, assist mechanism **208** reduces force **238** necessary for human operator **236** to close stowage bin **206**. Closing force **234** may increase as weight **230** of number of items **224** in stowage bin **206** increases. Closing force **234** reduces force **238** required to move stowage bin **206** from open position **226** to closed position **228**. Closing force **234** may be part of a range of possible assistive closing forces. Assistive closing forces are forces that help move stowage bin **206** from open position **226** to closed position **228**.

A value of closing force **234** may be changed by changing aspects of assist mechanism **208** such as distance **240**, lever arm **241**, mechanical advantage **242**, or a position of at least one structure of assist mechanism **208**. Lever arm **241** may be a distance between fulcrum **277** and one or more components of assist mechanism **208**. Fulcrum **277** is a point on which closing force **234** pivots. Fulcrum **277** may also be called an axis of rotation. A lever arm is a distance between a point of application of a force and a point about which the force rotates.

Distance **240** represents the distance between pivot **232** and one or more components of assist mechanism **208**. In some illustrative examples, distance **240** may represent a length of lever arm **241** of assist mechanism **208**. In these illustrative examples, assist mechanism **208** may be directly connected to stowage bin **206**.

As depicted, closing force **234** is related to lever arm **241**. Specifically, the value of closing force **234** is related to lever arm **241**. Lever arm **241** may be changed based on weight **230** of number of items **224** in stowage bin **206**. When lever arm **241** is changed, closing force **234** may also change. For example, lever arm **241** has a first length when a first amount of opening torque **243** that is applied to stowage bin **206** by number of items **224** and a second length that is greater than the first length when a second amount of opening torque **243** is applied to stowage bin **206** by number of items **224**, and the second amount is greater than the first amount.

In this depicted example, assist mechanism **208** has mechanical advantage **242**. Mechanical advantage **242** is a measure of force amplification achieved by using assist mechanism **208**. Mechanical advantage **242** changes based on a change of lever arm **241**.

As depicted, assist mechanism **208** includes force generation device **246** and adjustment mechanism **248**. Force generation device **246** includes a number of components attached to stowage bin **206**. Force generation device **246** provides force assist in closing stowage bin **206**. Specifically, force generation device **246** generates first force **249** to provide closing force **234** to move stowage bin **206** from open position **226** to closed position **228**. In this depicted example, force generation device **246** may comprise at least one of tension spring **203**, compression spring **205**, torsion spring **247**, strut **207**, gas strut **209**, weight **211**, motor **213**, magnet **215**, or other desirable force generation devices. These components may be connected to stowage bin **206** or arranged about stowage bin **206** such that assist mechanism **208** provides closing force **234**. In some illustrative examples, assist mechanism **208** has mechanical advantage **242** that changes to provide closing force **234**.

As depicted, force generation device **246** has fixed end **250** and movable end **252**. In this depicted example, fixed end **250** does not move relative to the structure that it is attached to. In an illustrative example, fixed end **250** of force generation device **246** is attached to structure **218** in platform **204**. In another illustrative example, fixed end **250** of force generation device **246** is attached to stowage bin **206**. In either case, although fixed end **250** may pivot or rotate about this attachment point, it does not move a distance from the attachment point.

In this illustrative example, movable end **252** of force generation device **246** moves back and forth along path **254**. In some illustrative examples, movable end **252** moves along path **254** in an arc about fixed end **250** to change the length of lever arm **241**. Adjustment mechanism **248** comprises a number of components attached to movable end **252** of force generation device **246**. Adjustment mechanism **248** moves movable end **252** to change lever arm **241** to provide closing force **234**. In other words, adjustment mechanism **248** moves movable end **252** to change a distance between movable end

252 and fulcrum 277 to provide closing force 234. Adjustment mechanism 248 may adjust closing force 234 based on data from number of sensors 210.

In this depicted example, a distance between fulcrum 277 and movable end 252 of force generation device 246 may increase as weight 230 of number of items 224 in stowage bin 206 increases. In a similar fashion, a distance between fulcrum 277 and movable end 252 of force generation device 246 may decrease as weight 230 of number of items 224 in stowage bin 206 decreases.

In an illustrative example, adjustment mechanism 248 includes various components. For example, adjustment mechanism 248 may include mechanical, electromechanical, or other types of components. In this illustrative example, adjustment mechanism 248 may take the form of an actuator.

As depicted, adjustment mechanism 248 moves movable end 252 of force generation device 246 along path 254. In this illustrative example, path 254 may be a predefined track for movable end 252 of force generation device 246.

Path 254 is an arc about fixed end 250 in this illustrative example. In this manner, movable end 252 of force generation device 246 moves in a curved path about an axis shared with fixed end 250.

In some illustrative examples, guide device 256 is a structure that guides movable end 252 of force generation device 246 along path 254. Guide device 256 guides movement of point of application 257 of first force 249 along path 254. Guide device 256 may be selected from one of track 217, linkage 219, rail 221, groove 223, or other desirable components.

As illustrated, number of sensors 210 is connected to structure 218, stowage bin 206, or both. In this illustrative example, number of sensors 210 may include one or more pressure sensors, load cells, distance sensors, cameras, or other types of sensors. Number of sensors 210 measures a number of forces on stowage bin 206. Number of sensors 210 identifies at least one of weight 230 of number of items 224 in stowage bin 206, an amount of force 238 applied to structure 218 by number of items 224 in stowage bin 206, or an amount of force 238 applied to handle 220 of stowage bin 206 by human operator 236.

Number of sensors 210 supplies data 255. In some examples, assist mechanism 208 has lever arm 241 between point of application 257 of first force 249 by force generation device 246 and an axis of rotation, and the length of lever arm 241 is changed based on an amount of opening torque 243 applied to stowage bin 206 by number of items 224 as determined based on data 255 from number of sensors 210.

Number of sensors 210 includes first sensor 259 and second sensor 261. First sensor 259 may take a measurement of amount of opening force 263 applied to stowage bin 206. In one illustrative example, amount of opening force 263 applied to stowage bin 206 is an amount of opening torque 243 applied by number of items 224 within stowage bin 206 and an amount of force 238 applied to handle 220 of stowage bin 206 by human operator 236. In another illustrative example, the amount of opening force 263 applied to stowage bin 206 is an amount of opening torque 243 applied by number of items 224 within stowage bin 206. Second sensor 261 may take a measurement of the amount of force 238 applied to handle 220 of stowage bin 206 by human operator 236.

In this illustrative example, number of sensors 210 communicates with controller 212. Controller 212 also communicates with adjustment mechanism 248. Controller 212 may communicate with at least one of number of sensors 210 or adjustment mechanism 248 using any number of wireless communications links, wired communications links, optical communications links, or other types of communications links. Controller 212 compares data from number of sensors 210. Controller 212 is a device that identifies a desired value for closing force 234 to be provided by assist mechanism 208 based on data from number of sensors 210. Controller 212 may also direct adjustment mechanism 248 to change a position of at least one structure of assist mechanism 208 to provide closing force 234. Specifically, controller 212 may direct adjustment mechanism 248 to change a length of lever arm 241 of assist mechanism 208 to provide closing force 234. For example, controller 212 may generate commands to control the operation of adjustment mechanism 248. Adjustment mechanism 248 may move point of application 257 of first force 249 by force generation device 246 to change the length of lever arm 241 based on amount of opening torque 243 applied to stowage bin 206 by number of items 224.

In this depicted example, controller 212 identifies desired position 260 for force generation device 246 based on a desired value for closing force 234, and activates adjustment mechanism 248 to move force generation device 246 to desired position 260. For example, adjustment mechanism 248 may move movable end 252 of force generation device 246 to desired position 260.

Desired position 260 may be a position along path 254. Distance 240 is the distance from pivot 232 of stowage bin 206 and desired position 260 of force generation device 246.

In this illustrative example, controller 212 may be implemented in software, hardware, firmware, or a combination thereof. When software is used, the operations performed by controller 212 may be implemented using, for example, without limitation, program code configured to run on a processor unit. When firmware is used, the operations performed by controller 212 may be implemented using, for example, without limitation, program code and data and stored in persistent memory to run on a processor unit.

When hardware is employed, the hardware may include one or more circuits that operate to perform the operations in performed by controller 212. Depending on the implementation, the hardware may take the form of a circuit system, an integrated circuit, an application specific integrated circuit (ASIC), a programmable logic device, or some other suitable type of hardware device configured to perform any number of operations.

A programmable logic device may be configured to perform certain operations. The device may be permanently configured to perform these operations or may be reconfigurable. A programmable logic device may take the form of, for example, without limitation, a programmable logic array, a programmable array logic, a field programmable logic array, a field programmable gate array, or some other type of programmable hardware device.

In some illustrative examples, the operations, processes, or both performed by controller 212 may be performed using organic components integrated with inorganic components. In some cases, the operations, processes, or both may be performed by entirely organic components, excluding a human being. As one illustrative example, circuits in organic semiconductors may be used to perform these operations, processes, or both.

As illustrated, movement inhibitor 214 includes a number of components physically associated with movable end 252 of force generation device 246. Movement inhibitor 214 locks movable end 252 in place when stowage bin 206 is in open position 226. For example, after movable end 252 is moved a desired distance from pivot 232, movement inhibitor 214 prevents movable end 252 from moving out of position. As an example, movement inhibitor 214 reduces slippage or other undesired movement to ensure that a desired value for closing force **234** is maintained. Movement inhibitor **214** is associated with point of application **257** of first force **249** by force generation device **246**, wherein movement inhibitor **214** engages to substantially prevent the length of lever arm **241** from changing as stowage bin **206** moves from open position **226** to closed position **228**.

As used herein, a first component, such as movement inhibitor **214**, may be considered to be associated with a second component, such as movable end **252** of force generation device **246**, by being secured to the second component, bonded to the second component, mounted to the second component, welded to the second component, fastened to the second component, connected to the second component in some other suitable manner, or a combination thereof. The first component also may be connected to the second component using a third component. Further, the first component may be considered to be associated with the second component by being formed as part of, as an extension of the second component, or a combination thereof.

In this depicted example, locking mechanism **216** is connected to stowage bin **206**. Locking mechanism **216** locks stowage bin **206** in open position **226** while movable end **252** of force generation device **246** moves relative to pivot **232** of stowage bin **206**. Locking mechanism **216** locks stowage bin **206** in open position **226** while length of lever arm **241** changes. In this manner, human operator **236** cannot close stowage bin **206** until distance **240** is set to provide a desired value of closing force **234** in closing stowage bin **206**.

Movement inhibitor **214** and locking mechanism **216** each may comprise the same or different types of components in this illustrative example. For instance, movement inhibitor **214**, locking mechanism **216**, or both may comprise at least one of rack and pinion **225**, clamp **227**, roller cam clamp **229**, non-back drive actuator **231**, latch **235**, magnetic lock **237**, or other suitable components.

The illustration of overhead stowage system **202** in FIG. **2** is not meant to imply physical or architectural limitations to the manner in which an illustrative embodiment may be implemented. Other components in addition to or in place of the ones illustrated may be used. Some components may be optional. Also, the blocks are presented to illustrate some functional components. One or more of these blocks may be combined, divided, or combined and divided into different blocks when implemented in an illustrative embodiment.

Although the illustrative examples are for an illustrative embodiment and are described with respect to an aircraft, an illustrative embodiment may be applied to other types of platforms. Platform **204** may be, for example, without limitation, a mobile platform, a stationary platform, a land-based structure, an aquatic-based structure, and a space-based structure. More specifically, platform **204** may be a surface ship, a tank, a personnel carrier, a train, a spacecraft, a submarine, an automobile, a house, a manufacturing facility, a building, and other suitable platforms.

Further, in some illustrative examples, controller **212**, number of sensors **210**, or both may be absent. Instead, a desired value for closing force **234** may be manually set, determined by mechanical devices, or some combination thereof.

Turning now to FIG. **3**, an illustration of a force diagram of a stowage bin is depicted in accordance with an illustrative embodiment. In stowage environment **300**, stowage bin **302** is movably connected to structure **304**. The movable connection between stowage bin **302** and structure **304** has a number of pivot points. As depicted, stowage bin **302** has pivot point **306**. In other illustrative embodiments, stowage bin **302** may have more than one pivot point or other types of articulation.

As depicted, human operator **308** applies force **310** to move stowage bin **302** from open position **311** to a closed position. Other forces on stowage bin **302** include weight **312** of a number of items within stowage bin **302**, closing force **314**, and weight **315** of stowage bin **302** itself. Weight **315** remains constant. However, weight **312** of the number of items increases or decreases as items are added or removed from stowage bin **302**. Closing force **314** is provided by an assist mechanism (not pictured). Closing force **314** is adjustable across a range of values. Closing force **314** is increased or decreased by changing a mechanical advantage of the assist mechanism. By increasing closing force **314**, force **310** is decreased. In other words, closing force **314** is an assistive closing force. Closing force **314** is part of a range of possible assistive closing forces. Closing force **314** reduces force **310** required to move stowage bin **302** from open position **311** to a closed position.

As depicted, number of items within stowage bin **302** would have center of gravity **316**. Stowage bin **302** has center of gravity **318**. Each force has a respective lever arm. A number of items within stowage bin **302** has lever arm **320**. Stowage bin **302** has lever arm **322**. Force **310** has lever arm **324**. Closing force **314** has lever arm **326**. By changing lever arm **326**, the value of closing force **314** changes. For example, when weight **312** increases, lever arm **326** may be changed to increase the value of closing force **314**. As another example, when items are removed from stowage bin **302** to decrease weight **312**, lever arm **326** may be changed to decrease the value of closing force **314**.

As depicted, fulcrum **328** is the same as pivot point **306** of stowage bin **302**. However, in other illustrative examples, fulcrum **328** may be positioned in locations other than pivot point **306** of stowage bin **302**.

Turning now to FIG. **4**, an illustration of one example of a closed stowage bin with minimal assistive closing force is depicted in accordance with an illustrative embodiment. As depicted, stowage environment **400** includes stowage bin **402**, and assist mechanism **406**. Stowage bin **402** may be a physical implementation of stowage bin **206** in stowage environment **200** of FIG. **2**. Stowage bin **402** is in closed position **407**. Stowage bin **402** is directly movably connected to a structure by pivot **408**.

Assist mechanism **406** includes force generation device **410**, adjustment mechanism **412**, and guide device **414**. As depicted, force generation device **410** takes the form of strut **416**. Force generation device **410** has fixed end **418** and movable end **420**. Fixed end **418** remains connected to stowage bin **402** in the same location. Movable end **420** translates along guide device **414** to change a closing force supplied by assist mechanism **406**. Movable end **420** may be moved to and maintained at various positions along guide device **414**. The closing force has a value within a range of assistive closing force values. As depicted, force generation device **410** is positioned to provide a minimum value for an assistive closing force.

Adjustment mechanism **412** moves movable end **420** along guide device **414** to change the closing force supplied by assist mechanism **406**. Adjustment mechanism **412** may adjust the closing force based on data from a number of sensors. As depicted, adjustment mechanism **412** takes the form of an actuator movably connected to the structure at pivot point **421**.

In this illustrative example, guide device **414** is an arc. Guide device **414** has first end **422** and second end **424**. When movable end **420** is at first end **422**, the closing force has a minimum value. When movable end **420** is at second end **424**, the closing force has a maximum value.

Number of sensors **426** is associated with stowage bin **402**. Number of sensors **426** may measure a number of forces on stowage bin **402**. Number of sensors **426** may supply data. As depicted, number of sensors **426** includes first sensor **428** and second sensor **430**. First sensor **428** may take a measurement of an amount of opening force applied to stowage bin **402**. The amount of opening force applied to stowage bin **402** is an amount of opening torque applied by a number of items within stowage bin **402** and an amount of force applied to the handle of stowage bin **402** by a human operator. Second sensor **430** takes a measurement of the amount of force applied to the handle of stowage bin **402** by the human operator. Data from first sensor **428** and second sensor **430** may be used to determine the amount of opening torque applied by the number of items. The determined amount of opening torque applied by the number of items may be used to determine a desired closing force to be supplied by assist mechanism **406**.

Turning now to FIG. **5**, an illustration of one example of an open stowage bin with minimal assistive closing force is depicted in accordance with an illustrative embodiment. View **500** is a view of stowage bin **402** in open position **502**. Specifically, stowage bin **402** has rotated clock-wise about pivot **408** from closed position **407** of FIG. **4**.

Turning now to FIG. **6**, an illustration of one example of a closed stowage bin with maximum assistive closing force is depicted in accordance with an illustrative embodiment. View **600** is a view of stowage bin **402** in closed position **407**. As depicted, adjustment mechanism **412** has moved movable end **420** of force generation device **410** to second end **424** of guide device **414**.

Turning now to FIG. **7**, an illustration of one example of an open stowage bin with maximum assistive closing force in accordance with an illustrative embodiment. View **700** is a view of stowage bin **402** in open position **502** with maximum assistive closing force. Specifically, stowage bin **402** has rotated clock-wise about pivot **408** from closed position **407** of FIG. **6**.

Turning now to FIG. **8**, an illustration of another example of an open stowage bin with maximum assistive closing force is depicted in accordance with an illustrative embodiment. As depicted, stowage environment **800** includes stowage bin **802** and assist mechanism **806**. Stowage bin **802** may be a physical implementation of stowage bin **206** in stowage environment **200** of FIG. **2**. Stowage bin **802** is in open position **807**. Stowage bin **802** is directly movably connected to the structure by pivot **808**.

Assist mechanism **806** includes force generation device **810**, adjustment mechanism **812**, and guide device **814**. As depicted, force generation device **810** takes the form of compression strut **816**. Force generation device **810** has fixed end **818** and movable end **820**. Fixed end **818** remains connected to linkage **822**. Linkage **822** is connected to stowage bin **802** and the structure (not depicted). Movable end **820** translates along guide device **814** to change a closing force supplied by assist mechanism **806**. Movable end **820** may be moved to and maintained at various positions along guide device **814**. The closing force has a value within a range of assistive closing force values. As depicted, force generation device **810** is positioned to provide a maximum value for an assistive closing force.

Adjustment mechanism **812** moves movable end **820** along guide device **814** to change the closing force supplied by assist mechanism **806**. Adjustment mechanism **812** may adjust the closing force based on data from a number of sensors. As depicted, adjustment mechanism **812** takes the form of an actuator movably connected to structure **804** at pivot point **824**.

In this illustrative example, guide device **814** is an arc. Guide device **814** has first end **826** and second end **828**. When movable end **820** is at first end **826**, the closing force has a maximum value. When movable end **820** is at second end **828**, the closing force has a minimum value.

Number of sensors **830** is associated with stowage bin **802**. Number of sensors **830** may measure a number of forces on stowage bin **802**. Number of sensors **830** may supply data. As depicted, number of sensors **830** includes first sensor **832**. First sensor **832** may take a measurement of an amount of an opening force applied to stowage bin **802**. The amount of opening force applied to stowage bin **802** is an amount of opening torque applied by a number of items within stowage bin **802**. As depicted, first sensor **832** is able to measure the amount of opening torque applied by a number of items within stowage bin **802** directly. As a result, number of sensors **830** does not include a second sensor to take a measurement of the amount of force applied to the handle of stowage bin **802** by the human operator in this illustrative example. Data from first sensor **832** may be used to determine a desired closing force to be supplied by assist mechanism **806**. The determined amount of opening torque applied by the number of items may be used to determine a desired closing force to be supplied by assist mechanism **806**.

Turning now to FIG. **9**, an illustration of a further example of an open stowage bin with minimum assistive closing force is depicted in accordance with an illustrative embodiment. As depicted, stowage environment **900** includes stowage bin **902**, structure **904**, and assist mechanism **906**. Stowage bin **902** may be a physical implementation of stowage bin **206** in stowage environment **200** of FIG. **2**. Stowage bin **902** is in open position **907**. Stowage bin **902** is movably connected to structure **904** by pivot **908**. As depicted, pivot **908** is directly connected to structure **904**. As depicted, structure **904** is an airframe.

Assist mechanism **906** includes force generation device **910**, adjustment mechanism **912**, and guide device **914**. As depicted, force generation device **910** takes the form of torsion spring **915** and cable **916**. Force generation device **910** has fixed end **918** and movable end **920**. Fixed end **918** remains connected to structure **904**. Movable end **920** translates along guide device **914** to change a closing force supplied by assist mechanism **906**. Movable end **920** may be moved to and maintained at various positions along guide device **914**. Movable end **920** may be maintained at a position by movement inhibitor **921**. The closing force has a value within a range of assistive closing force values. As depicted, force generation device **910** is positioned to provide a minimum value for an assistive closing force.

Adjustment mechanism **912** moves movable end **920** along guide device **914** to change the closing force supplied by assist mechanism **906**. Adjustment mechanism **912** may adjust the closing force based on data from a number of sensors. As depicted, adjustment mechanism **912** takes the form of an actuator movably connected to stowage bin **902**.

In this illustrative example, guide device **914** is an arc. Guide device **914** has first end **922** and second end **924**. When movable end **920** is at first end **922**, the closing force has a minimum value. When movable end **920** is at second end **924**, the closing force has a maximum value.

Number of sensors **926** is associated with stowage bin **902**. Number of sensors **926** may measure a number of forces on stowage bin **902**. Number of sensors **926** may supply data. As depicted, number of sensors **926** includes first sensor **928**.

First sensor **928** may take a measurement of an amount of opening force applied to stowage bin **902**. The amount of opening force applied to stowage bin **902** is an amount of opening torque applied by a number of items within stowage bin **902**. As depicted, first sensor **928** is able to measure the amount of opening torque applied by a number of items within stowage bin **902** directly. As a result, number of sensors **926** does not include a second sensor to take a measurement of the amount of force applied to the handle of stowage bin **902** by the human operator in this illustrative example. Data from first sensor **928** may be used to determine a desired closing force to be supplied by assist mechanism **906**. The determined amount of opening torque applied by the number of items may be used to determine a desired closing force to be supplied by assist mechanism **906**. In other illustrative examples, number of sensors **926** may include a second sensor to provide additional data for determining a desired closing force.

Turning now to FIG. **10**, an illustration of a further example of an open stowage bin with an assistive closing force is depicted in accordance with an illustrative embodiment. View **1000** is a view of stowage bin **902** in open position **907** with a second closing force. Specifically, this second closing force is a greater closing force than depicted in FIG. **9**. This second closing force is accomplished by moving movable end **920** from first end **922** to location **1002** on guide device **914**.

Turning now to FIG. **11**, an illustration of a further example of an open stowage bin with an assistive closing force is depicted in accordance with an illustrative embodiment. View **1100** is a view of stowage bin **902** in open position **907** with a third closing force. Specifically, this third closing force is a greater closing force than depicted in either FIG. **9** or FIG. **10**. This third closing force is accomplished by moving movable end **920** from location **1002** to location **1102** on guide device **914**.

Turning now to FIG. **12**, an illustration of a simplified view of a yet further example of a closed stowage bin with a minimum assistive closing force is depicted in accordance with an illustrative embodiment. As depicted, stowage environment **1200** includes stowage bin **1202** and assist mechanism **1204**. Stowage bin **1202** may be a physical implementation of stowage bin **206** in stowage environment **200** of FIG. **2**. Stowage bin **1202** is in closed position **1206**. Stowage bin **1202** is movably connected to a structure by number of pivots **1208**. As depicted, number of pivots **1208** takes the form of a four-bar assembly.

Assist mechanism **1204** includes force generation device **1210** and guide device **1212**. An adjustment mechanism is not depicted, but would be used to move movable end **1214** of force generation device **1210**. As depicted, force generation device **1210** takes the form of strut **1216**. Strut **1216** may be a gas strut. In other illustrative examples, a tension spring enclosed within a housing may be used instead of strut **1216**. Force generation device **1210** has fixed end **1218** and movable end **1214**. Fixed end **1218** remains connected to an aircraft structure (not depicted). Movable end **1214** translates along guide device **1212** to change a closing force supplied by assist mechanism **1204**. Movable end **1214** may be moved to and maintained at various positions along guide device **1212**. The closing force has a value within a range of assistive closing force values. As depicted, force generation device **1210** is positioned to provide a minimum value for an assistive closing force.

In this illustrative example, guide device **1212** is an arc. Guide device **1212** has first end **1220** and second end **1222**. When movable end **1214** is at first end **1220**, the closing force has a maximum value. When movable end **1214** is at second end **1222**, the closing force has a minimum value.

Although not depicted in this simplified illustration, several other components may be present in this example. For example, this embodiment may have at least one of an adjustment mechanism, controller, or number of sensors.

Turning now to FIG. **13**, an illustration of a simplified view of a yet further example of an open stowage bin with a minimum assistive closing force is depicted in accordance with an illustrative embodiment. View **1300** is a view of stowage bin **1202** in open position **1302**. As depicted, adjustment mechanism (not shown) has moved movable end **1214** of force generation device **1210** to second end **1222** of guide device **1212**.

Turning now to FIG. **14**, an illustration of a simplified view of a yet further example of a closed stowage bin with a minimum assistive closing force is depicted in accordance with an illustrative embodiment. As depicted, stowage environment **1400** includes stowage bin **1402** and assist mechanism **1404**. Stowage bin **1402** may be a physical implementation of stowage bin **206** in stowage environment **200** of FIG. **2**. Stowage bin **1402** is in closed position **1406**. Stowage bin **1402** is movably connected to a structure by number of pivots **1408**. As depicted, number of pivots **1408** takes the form of four bar linkage **1409**.

Assist mechanism **1404** includes force generation device **1410** and guide **1412**. An adjustment mechanism is not depicted, but would be used to move movable end **1414** of force generation device **1410**. As depicted, force generation device **1410** takes the form of compression strut **1416**. Force generation device **1410** has fixed end **1418** and movable end **1414**. Fixed end **1418** remains connected to an aircraft structure (not depicted). Movable end **1414** translates along guide **1412** to change a closing force supplied by assist mechanism **1404**. Movable end **1414** may be moved to and maintained at various positions along guide **1412**. The closing force has a value within a range of assistive closing force values. As depicted, force generation device **1410** is positioned to provide a minimum value for an assistive closing force.

In this illustrative example, guide **1412** is an arc. Guide **1412** has first end **1420** and second end **1422**. When movable end **1414** is at first end **1420**, the closing force has a maximum value. When movable end **1414** is at second end **1422**, the closing force has a minimum value.

Although not depicted in this simplified illustration, several other components may be present in this example. For example, this embodiment may have at least one of an adjustment mechanism, controller, or number of sensors.

Turning now to FIG. **15**, an illustration of a simplified view of a yet further example of an open stowage bin with a minimum assistive closing force is depicted in accordance with an illustrative embodiment. View **1500** is a view of stowage bin **1402** in open position **1502**. As depicted, adjustment mechanism (not shown) has moved movable end **1414** of force generation device **1410** to second end **1422** of guide **1412**.

The illustrations of stowage bins, number of pivot points, and assist mechanisms in FIGS. **3-15** are not meant to imply physical or architectural limitations to the manner in which an illustrative embodiment may be implemented. Other components in addition to or in place of the ones illustrated may be used. Some components may be optional.

The different components shown in FIGS. **1** and **3-15** may be illustrative examples of how components shown in block form in FIG. **2** can be implemented as physical structures. Additionally, some of the components in FIGS. **1** and **3-15** may be combined with components in FIG. **2**, used with components in FIG. **2**, or a combination of the two.

Turning now to FIG. **16**, an illustration of a flowchart of a process for providing a closing force is depicted in accordance with an illustrative embodiment. Process **1600** may be used to provide a closing force to reduce a force required to move a stowage bin from an open position to a closed position. Process **1600** may be used with stowage bin **206** of FIG. **2** to provide closing force **234**. Process **1600** may also be used with any stowage bins of FIGS. **3-15** to provide a closing force.

Process **1600** begins by taking a number of measurements of a number of forces applied to a stowage bin during operation of the stowage bin, wherein the number of measurements is taken by a number of sensors (operation **1602**). In some illustrative examples, the number of sensors includes a first sensor. This first sensor may measure an amount of opening force. The amount of opening force may be an amount of opening torque applied by a number of items within the stowage bin. Accordingly, taking the number of measurements of the number of forces applied to the stowage bin during operation of the stowage bin includes taking a measurement of the amount of opening torque applied to the stowage bin by a number of items within the stowage bin. This type of measurement may be referred to as a direct measurement.

In other illustrative examples, the number of sensors may include a first sensor and a second sensor. The first sensor may measure an amount of opening force applied to the stowage bin. The amount of opening force is an amount of opening torque applied by a number of items within the stowage bin and an amount of force applied to a handle of the stowage bin by a human operator. In these illustrative examples, the second sensor may take a measurement of the amount of force applied to the handle of the stowage bin by the human operator.

Process **1600** continues by comparing data from the number of sensors (operation **1604**). Comparing data from the number of sensors may include comparing the data from the number of sensors taken during the same time. For example, data from the first sensor may be compared to data from the second sensor. In some illustrative examples, comparing data from the number of sensors may include comparing data from different times. For example, current measurements may be compared to past measurements to determine if a weight of a number of items within the stowage bin has changed.

Process **1600** then adjusts a closing force provided by an assist mechanism based on the data from the number of sensors (operation **1606**). In some illustrative examples, the closing force provided by the assist mechanism may be changed by changing a length of a lever arm of the assist mechanism.

Process **1600** may then provide the closing force by the assist mechanism, wherein the assist mechanism has a mechanical advantage that changes to provide the closing force (operation **1608**). Afterwards, the process terminates.

The flowcharts and block diagrams in the different depicted embodiments illustrate the architecture, functionality, and operation of some possible implementations of apparatuses and methods in an illustrative embodiment. In this regard, each block in the flowcharts or block diagrams may represent at least one of module, a segment, a function, or a portion a combination thereof of an operation or step.

In some alternative implementations of an illustrative embodiment, the function or functions noted in the blocks may occur out of the order noted in the figures. For example, in some cases, two blocks shown in succession may be executed substantially concurrently, or the blocks may sometimes be performed in the reverse order, depending upon the functionality involved. Also, other blocks may be added in addition to the illustrated blocks in a flowchart or block diagram.

In some illustrative examples, the process may also identify, by the controller, a value for the closing force based on the number of measurements. The value for the closing force may be identified based on at least one of the value of the opening torque, a value of the force provided by a human operator on the handle of the stowage bin, or a total force on the stowage bin. The process may further direct the adjustment mechanism to change a position of at least one structure of the assist mechanism to provide the value for the closing force. For example, a controller may direct the adjustment mechanism to move a movable end of a force generation device to provide a value for the closing force. In some illustrative examples, providing the closing force may include generating a first force by a force generation device of the assist mechanism to provide the closing force, wherein the force generation device comprises at least one of a tension spring, a compression spring, a torsion spring, a strut, a gas strut, a weight, a motor, or a magnet.

In some illustrative examples, taking the number of measurements of the number of forces applied to the stowage bin during operation of the stowage bin includes taking a measurement of the amount of opening torque applied to the stowage bin by a number of items within the stowage bin. The method may also change a length of a lever arm of the assist mechanism based on the measurement of the amount of opening torque applied to the stowage bin by the number of items, wherein the lever arm is between a point of application of the closing force by the assist mechanism and an axis of rotation. The axis of rotation may also be called a fulcrum. In some illustrative examples, the process may move the point of application of the first force of the force generation device by the adjustment system to change the length of the lever arm based on the amount of opening torque applied to the stowage bin by the number of items. In some illustrative examples, moving the point of application of the first force of the force generation device comprises guiding movement of the point of application of the first force along a path by a guide device, wherein the guide device is selected from at least one of a track, a linkage, a rail, or a groove.

In some illustrative examples, the process places a number of items into the stowage bin while the stowage bin is in the open position such that the stowage bin contains the number of items. The process may take a second number of measurements of a second number of forces applied to the stowage bin during operation of the stowage bin following placing the number of items into the stowage bin, wherein the second number of measurements is taken by the number of sensors. The process may compare data from the number of sensors related to the second number of measurements.

In some illustrative examples, the process may then adjust the closing force provided by the assist mechanism based on the data from the number of sensors related to the second number of measurements to form an increased closing force, wherein adjusting the closing force includes changing the mechanical advantage of the assist mechanism. Afterwards, the process may provide the increased closing force by the assist mechanism. Thus, the closing force may change as the number of items changes within the stowage bin.

The illustrative embodiments of the present disclosure may be described in the context of aircraft manufacturing and service method **1700** as shown in FIG. **17** and aircraft **1800** as shown in FIG. **18**. Turning first to FIG. **17**, an illustration of an aircraft manufacturing and service method is depicted in accordance with an illustrative embodiment. During pre-production, aircraft manufacturing and service method **1700** may include specification and design **1702** of aircraft **1800** in FIG. **18** and material procurement **1704**.

During production, component and subassembly manufacturing **1706** and system integration **1708** of aircraft **1800** in FIG. **18** takes place. Thereafter, aircraft **1800** in FIG. **18** may go through certification and delivery **1710** in order to be placed in service **1712**. While in service **1712** by a customer, aircraft **1800** in FIG. **18** is scheduled for routine maintenance and service **1714**, which may include modification, reconfiguration, refurbishment, and other maintenance or service.

Each of the processes of aircraft manufacturing and service method **1700** may be performed or carried out by a system integrator, a third party, an operator, or a combination thereof. In these examples, the operator may be a customer. For the purposes of this description, a system integrator may include, without limitation, any number of aircraft manufacturers and major-system subcontractors; a third party may include, without limitation, any number of vendors, subcontractors, and suppliers; and an operator may be an airline, a leasing company, a military entity, a service organization, and so on.

With reference now to FIG. **18**, an illustration of an aircraft is depicted in which an illustrative embodiment may be implemented. In this example, aircraft **1800** is produced by aircraft manufacturing and service method **1700** in FIG. **17** and may include airframe **1802** with plurality of systems **1804** and interior **1806**. Examples of systems **1804** include one or more of propulsion system **1808**, electrical system **1810**, hydraulic system **1812**, and environmental system **1814**. Any number of other systems may be included. Although an aerospace example is shown, different illustrative embodiments may be applied to other industries, such as the automotive industry.

Apparatuses and methods embodied herein may be employed during at least one of the stages of aircraft manufacturing and service method **1700** in FIG. **17**. In particular, stowage bin **206** and assist mechanism **208** from FIG. **2** may be used during any one of the stages of aircraft manufacturing and service method **1700**. For example, without limitation, assist mechanism **208** from FIG. **2** may be used to provide closing force during at least one of component and subassembly manufacturing **1706**, system integration **1708**, routine maintenance and service **1714**, or some other stage of aircraft manufacturing and service method **1700**.

In one illustrative example, components or subassemblies produced in component and subassembly manufacturing **1706** in FIG. **17** may be fabricated or manufactured in a manner similar to components or subassemblies produced while aircraft **1800** is in service **1712** in FIG. **17**. As yet another example, one or more apparatus embodiments, method embodiments, or a combination thereof may be utilized during production stages, such as component and subassembly manufacturing **1706** and system integration **1708** in FIG. **17**. One or more apparatus embodiments, method embodiments, or a combination thereof may be utilized while aircraft **1800** is in service **1712**, during maintenance and service **1714** in FIG. **17**, or a combination thereof. The use of a number of the different illustrative embodiments may substantially expedite the assembly, reduce the cost of aircraft **1800**, or both.

Thus, the illustrative embodiments provide a stowage bin having an assistive mechanism providing a closing force to reduce a force required to move the stowage bin from an open position to a closed position. The closing force may be increased or decreased along a range of values. The closing force may be increased or decreased based on a weight of a number of items within the stowage bin. The weight of the number of items may create an opening torque on the stowage bin. The opening torque may be determined based on data provided by a number of sensors. In some examples, the number of sensors may directly measure the opening torque on the stowage bin. In other examples, the number of sensors may instead indirectly measure the opening torque on the stowage bin by measuring a total force on the stowage bin.

By providing a closing force, an assist mechanism may allow for stowage bins to have increased capacity without increasing the amount of force a human operator must apply to open or close the stowage bin. By providing a closing force, an assist mechanism may allow for stowage bins to be placed higher within the cabin of an aircraft. Having stowage bins placed higher within the cabin may provide increased passenger comfort and mobility. By providing a closing force, heavier items may be placed within a stowage bin without substantially increasing the force a human operator must apply to open or close the stowage bin.

The illustrative embodiments may provide an assistive closing force without an undesirable amount of added weight. Further, the illustrative embodiments may provide an assistive closing force without power requirements of other 'solutions' such as motorized bins. The illustrative embodiments may automatically adjust to variable load conditions caused by adding or removing a number of items within the stowage bin. Further, the illustrative embodiments may provide an assistive closing force without undesirably limiting or undesirably impacting the functionality or operation of the stowage bin.

The description of the different illustrative embodiments has been presented for purposes of illustration and description, and is not intended to be exhaustive or limited to the embodiments in the form disclosed. Many modifications and variations will be apparent to those of ordinary skill in the art. Further, different illustrative embodiments may provide different features as compared to other desirable embodiments. The embodiment or embodiments selected are chosen and described in order to best explain the principles of the embodiments, the practical application, and to enable others of ordinary skill in the art to understand the disclosure for various embodiments with various modifications as are suited to the particular use contemplated.

What is claimed is:

1. An apparatus comprising:

a stowage bin;

a number of sensors that measure a number of forces on the stowage bin, wherein the number of sensors comprises a first sensor to take a measurement of an amount of opening force applied to the stowage bin, wherein the amount of opening force applied to the stowage bin comprises an amount of force applied to a handle of the stowage bin by a human operator;

an assist mechanism that provides a closing force, wherein the assist mechanism has a mechanical advantage that changes to provide the closing force;

a controller that compares data from the number of sensors; and

an adjustment mechanism that adjusts the closing force based on the data from the number of sensors.

2. The apparatus of claim **1**, wherein the closing force reduces a force required to move the stowage bin from an open position to a closed position, and wherein the closing force is part of a range of possible assistive closing forces.

3. The apparatus of claim **1**, wherein the controller identifies the closing force based on the data from the number of sensors and directs the adjustment mechanism to change a position of at least one structure of the assist mechanism to provide the closing force.

4. The apparatus of claim **3**, wherein the controller directs the adjustment mechanism to change a length of a lever arm of the assist mechanism to provide the closing force.

5. The apparatus of claim **1**, wherein the amount of opening force applied to the stowage bin further comprises an amount of opening torque applied by a number of items within the stowage bin.

6. The apparatus of claim **5**, wherein the number of sensors further comprises a second sensor to take the measurement of the amount of force applied to the handle of the stowage bin by the human operator.

7. The apparatus of claim **1**, wherein the assist mechanism comprises:

a force generation device that generates a first force to provide the closing force to move the stowage bin from an open position to a closed position, the force generation device comprising at least one of a tension spring, a compression spring, a torsion spring, a strut, a gas strut, a weight, a motor, or a magnet.

8. The apparatus of claim **7**, wherein the number of sensors supplies the data, wherein the assist mechanism has a lever arm between a point of application of the closing force of the assist mechanism and an axis of rotation, and wherein a length of the lever arm is changed based on an amount of opening torque applied to the stowage bin by a number of items as determined based on the data from the number of sensors.

9. The apparatus of claim **8**, wherein the adjustment mechanism moves a point of application of the first force by the force generation device to change the length of the lever arm based on the amount of opening torque applied to the stowage bin by the number of items.

10. The apparatus of claim **9**, wherein the assist mechanism comprises:

a guide device that guides movement of the point of application of the first force along a path, wherein the guide device is selected from at least one of a track, a linkage, a rail, or a groove.

11. The apparatus of claim **8**, wherein the force generation device has a fixed end and a movable end, wherein the movable end moves along a path in an arc about the fixed end to change the length of the lever arm.

12. The apparatus of claim **8**, wherein the lever arm has a first length when a first amount of opening torque is applied to the stowage bin by the number of items and a second length that is greater than the first length when a second amount of opening torque is applied to the stowage bin by the number of items, and wherein the second amount of opening torque is greater than the first amount of opening torque.

13. The apparatus of claim **8** further comprising:

a movement inhibitor associated with a point of application of the first force by the force generation device, wherein the movement inhibitor engages to substantially prevent the length of the lever arm from changing as the stowage bin moves from the open position to the closed position.

14. The apparatus of claim **13**, wherein the movement inhibitor includes at least one of a rack and pinion, a clamp, a roller cam clamp, a non-back drive actuator, a latch, or a magnetic lock.

15. The apparatus of claim **8** further comprising:

a locking mechanism connected to the stowage bin, wherein the locking mechanism locks the stowage bin in the open position while the length of the lever arm changes.

16. A method comprising:

taking a number of measurements of a number of forces applied to a stowage bin during operation of the stowage bin, wherein the number of measurements is taken by a number of sensors, wherein the number of sensors comprises a first sensor to take a measurement of an amount of opening force applied to the stowage bin, wherein the amount of opening force applied to the stowage bin comprises an amount of force applied to a handle of the stowage bin by a human operator;

comparing data from the number of sensors;

adjusting a closing force provided by an assist mechanism based on the data from the number of sensors; and

providing the closing force by the assist mechanism, wherein the assist mechanism has a mechanical advantage that changes to provide the closing force.

17. The method of claim **16** further comprising:

identifying, by a controller, a value for the closing force based on the number of measurements; and

directing an adjustment mechanism to change a position of at least one structure of the assist mechanism to provide the value for the closing force.

18. The method of claim **17**, wherein providing the closing force comprises:

generating a first force by a force generation device of the assist mechanism to provide the closing force, wherein the force generation device comprises at least one of a tension spring, a compression spring, torsion spring, a strut, a gas strut, a weight, a motor, or a magnet.

19. The method of claim **18**, wherein taking the number of measurements of the number of forces applied to the stowage bin during the operation of the stowage bin includes taking a measurement of an amount of opening torque applied to the stowage bin by a number of items within the stowage bin, and the method further comprising:

changing a length of a lever arm of the assist mechanism based on the measurement of the amount of opening torque applied to the stowage bin by the number of items, wherein the lever arm is between a point of application of the closing force by the assist mechanism and an axis of rotation.

20. The method of claim **19** further comprising:

moving a point of application of the first force of the force generation device by an adjustment system to change the length of the lever arm based on the amount of opening torque applied to the stowage bin by the number of items.

21. The method of claim **20**, wherein moving the point of application of the first force of the force generation device comprises guiding movement of the point of application of the first force along a path by a guide device, wherein the guide device is selected from at least one of a track, a linkage, a rail, or a groove.

22. The method of claim **17** further comprising:

placing a number of items into the stowage bin while the stowage bin is in an open position such that the stowage bin contains the number of items;

taking a second number of measurements of a second number of forces applied to the stowage bin during the operation of the stowage bin following placing the number of items into the stowage bin, wherein the second number of measurements is taken by the number of sensors;

comparing data from the number of sensors related to the second number of measurements;

adjusting the closing force provided by the assist mechanism based on the data from the number of sensors related to the second number of measurements to form an increased closing force, wherein adjusting the closing force includes changing the mechanical advantage of the assist mechanism; and

providing the increased closing force by the assist mechanism.

23. An apparatus comprising:

a stowage bin;

a pivot directly connected to the stowage bin and a structure such that the stowage bin may rotate about the pivot from an open position to a closed position;

a number of sensors that measure a number of forces on the stowage bin, wherein the number of sensors comprises a first sensor to take a measurement of an amount of opening force applied to the stowage bin, wherein the amount of opening force applied to the stowage bin comprises an amount of force applied to a handle of the stowage bin by a human operator; and

an assist mechanism that provides a closing force, wherein the assist mechanism has a mechanical advantage that changes to provide the closing force.

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